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To
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1855

AN EPITOME OF NAVIGATION, AND NAUTICAL ASTRONOMY,

WITH

IMPROVED LUNAR TABLES,

THE QUESTIONS

ARRANGED TO THE NAUTICAL ALMANAC FOR 1852,

Published by order of the Lords Commissioners of the Admiralty,

BY

JANET TAYLOR,

Dedicated by Permission
To the Honorable the Elder Brethren of the Corporation
of Trinity House, London.

NINTH EDITION.

TAYLOR, 104, MINORIES, LONDON.
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1851.

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TO THE HONORABLE

THE ELDER BRETHREN

OF THE

CORPORATION OF TRINITY HOUSE,

LONDON.

GENTLEMEN,

WITH feelings of deep-felt gratitude, I avail myself of your gracious permission, to dedicate to your Honorable Body, my "EPITOME OF NAVIGATION AND NAUTICAL ASTRONOMY."

In placing my Work, thus honored with your approbation, before the Public, I feel assured, the prominent position you occupy in this Maritime Kingdom, as the active Promoters and Encouragers of whatever tends to advance the real interests of Navigation, will secure for it the attention and support of the British Mariner.

With much respect, I subcribe myself,

GENTLEMEN,

Your gratefully obliged

and humble Servant,

JANET TAYLOR.

NAUTICAL ACADEMY,
104, MINORIES,
LONDON.

PREFACE.

IN launching this enlarged edition of my Epitome of Navigation before the Public, it will be unnecessary to enter into a detailed account of its contents. The slumbering spirit of research on this subject, which I awakened into activity, now nearly 20 years ago, has gone on adding improvement to improvement, and book to book, until the tide of information has swollen nearly to overwhelming my own little bark, which then was nearly alone on the wide ocean of mental darkness, which at that time overspread the Nautical world.

Suffice it then to say, that every care has been taken, that while nothing worthy of attention, or really important to the scientific or practical Navigator, has been omitted, all needless varieties of methods, and all extraneous matter, have been purposely avoided, that the attention of the Pupil may not wander from those essential points [redacted], the diligent study of which, will lead him on to the attainment of eminence in his profession.

The INTRODUCTION contains the requisite elementary information, at least, such as could alone be expected in a work of this kind. A description is given here of the Instruments used in navigating a ship at sea, with the method of finding the deviation of the compass in steam vessels, and correcting the courses for the errors found, a desideratum in this age of iron vessels, and Steam-boat Navigation

The SAILINGS comprehend every variety, and are given in a clear and simple manner, applicable to the general purposes of navigation. To this edition, I have added the principles of Great Circle Sailing, so much used by our countrymen, now traversing continually, the wide expanse of the Southern Ocean. I have endeavoured to make the subject clear and practical, and illustrated it by diagrams, shewing the spherical principles on which the tables now in use are calculated. As it is contrary to custom, though perfectly correct in theory, I think it better to mention, that in referring to the points and quarter points of the compass, I have avoided backing the compass; thus, what is usually called S.W. ¼ S. I have named S.W. by S. ¾ W. this, besides being more correct, can cause no misunderstanding with the practical seaman, and would be better if generally adopted.

The science of ASTRONOMY, so beautiful in itself as a study, leading the mind of man into close contemplation of the mightiest works of his Creator, and which, in its practical application, is of such vital importance to the navigator, is treated at much greater length in this volume, than is usual in works of the same kind: and its application to the determination of the Latitude and Longitude at sea, and various other important Nautical Problems, is pointed out as clearly as possible, to enable the student, by making him acquainted with the principles upon which they are founded, fully to understand, and easily to retain the rules for performing those operations which follow in the work.

The *Astronomical Definitions* are considered at much length, it being imperatively necessary, that the technical terms of a science should be well understood, before the language, in which the science itself is treated, can be properly intelligible, and to those anxious for a true knowledge of Nautical Astronomy, these definitions will prove of great benefit.

For determining the LATITUDE by observations of the celestial bodies, the most recent and approved methods are introduced, every advantage being taken to facilitate the operations without endangering accuracy of result.

The extension of the well-known problem, of finding the Latitude by Double Altitudes, to the purpose of finding the Longitude, affords another opportunity of ascertaining the exact position of the ship, and I take this occasion of thanking Mr. Riddle, for his kindness in calling my attention to the subject.

The method of ascertaining the LONGITUDE by Lunar observations, is distinguished by the simplicity of its principles, and the brevity of its operations, which are such as to render the clearing the distance, a work of a few minutes, while the accuracy of the results has been successfully tested by the *rigorous methods.* These advantages, of the highest consideration at sea, have obtained for this method of solving one of the most important problems in Nautical science, the approval of our most skilful and intelligent Navigators, and the patronage of the first Nautical authorities of this as well as of several Foreign Countries.

In addition to the usual methods of finding the Longitude, is given concise and accurate rules for computing the Longitude from the rising and setting of the sun, and when the Navigator will pay attention to his barometrical indications, and calculate for the amount of refraction at the time of taking his observations, this method will be of great service to him, giving him an opportunity before night comes on, of ascertaining the situation of his vessel.

The theory of the *rotatory storms* is but briefly touched on, as it would be impossible in a work of this kind to enter fully into those interesting branches so necessary to be fully understood by the seaman.

Col. Reid has kindly afforded me an opportunity of illustrating the course of rotary storms, and the method of "heaving-to, and sailing from a gale's centre," by the introduction of diagrams from his work, "The Developement of the Law of Storms," and to such scientific and able works on the subject, I must refer the Navigator, my present object being to arouse attention to this important branch of nautical science: by which the hands of the Navigator may be strengthened, in prosecuting his way across seas traversed by the terrific Cyclones.

In the Tables are little alterations, except that,—

Table 36 now commences from 10° of Altitude, and that part of it up to 18° inclusive, has been re-calculated with great care and attention; the remainder will be arranged to every two degrees, and added from time to time, as the calculations are completed; in the mean time all the corrections above 18°, must be used as formerly.

Table 4*a*, attached to the first few pages of Table 36, will be continued in subsequent Editions, as the calculations are finished, it is added for a reduction of the Moon's variable horizontal parallax, and is to be applied according to the directions given with the Table.

Table 43, introduced from p. 562 in the Nautical Almanac, has been added for the purpose of converting mean solar time into sidereal time, the difference between which periods, is fully explained in p. 150; by using sidereal time mean noon instead of the sun's right ascension, much trouble is spared, and there is less liability of error in the reduction; and in finding the mean time by observation of the Moon, Planets, or Fixed Stars, the equation of time is not requisite; the use of this Table is fully explained in page 167.

Table 43*a*, the mean reduction of the moon's horizontal parallax for the spheroidal figure of the earth, is added in an abridged form as the correction for general nautical purposes may be disregarded, and when used, the present form is sufficiently correct.

The Table of Latitudes and Longitudes, or "Position of Places," has been revised and corrected with the utmost care, from the most recent surveys and observations, and the best sources of hydrographical information. The principal light-houses, with their respective heights above high water, with a description of the nature of the light exhibited, have likewise been added, and will be found of great use.

The general Tables, which are stereotyped, have been carefully revised, and in their extensive use the few errors at the commencement, have alone been discovered; and it is hoped that the great attention bestowed on the work, throughout all its various subjects, and the desire to increase, not only the knowledge of her countrymen, but the facilities of applying that knowledge, will secure a continuance of that extensive public patronage, which is now most gratefully acknowledged by

THE AUTHORESS.

Nautical Academy,
May 1851,

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INTRODUCTION.

Explanation of Signs and Abbreviations used in the following Work.

SIGNS OR SYMBOLS.

+ *plus* Is the sign of *addition*, and being placed between two or more numbers or quantities, denotes that those numbers or quantities are to be added together; thus $5+9$, means that 9 is to be added to 5, and $a+b+c$, signifies the sum of the quantities represented by a b and c. The sign + is called the *positive* or *affirmative* sign, and the quantities having this sign prefixed to them, are called *positive* or *affirmative* quantities.

— *minus* Is the sign of *subtraction*, and shows that the number or quantity that follows it is to be taken from that which precedes it; thus $9-5$, signifies that 5 must be taken from 9, also $a+b-c$, denotes that the quantity c is to be taken from the sum of a and b. The sign — is called the *negative* sign, and a quantity having this sign prefixed to it, is called a *negative* quantity.

× *into* or *by* Is the sign of *multiplication*, and denotes that the numbers, or quantities between which it is placed, are to be multiplied together, thus 7×8, signifies 7 multiplied by 8, and $a\times b\times c$, shews that the quantities represented by a b and c are to be multiplied into one another. Multiplication is also sometimes denoted by putting a dot or point between the quantities to be multiplied together, thus $a\,.\,b\,.\,c$, signify the same as $a\times b\times c$.

÷ *divided by* Is the sign of *division*, and shews that the number or quantity standing before it, is to be divided by that which follows it, thus $84\div 12$, signifies that 84 is to be divided by 12. Division is, however, more simply expressed by making the former quantity the *numerator*, and the latter the *denominator*, of a fraction, thus $\frac{84}{12}$; also $a\div b$, or $\frac{a}{b}$, denotes that the quantity represented by a is to be divided by that represented by b.

= *equal to* Is the sign of *equality*, and shews that the numbers or quantities placed before it are equal to those which follow it; thus $4\times 9=36$, or 4×9 are equal to 36; so likewise $a+b=c+d$, means that $a+b$ are equal to $c+d$. When quantities are thus connected by the sign of equality, the expression itself is called an *equation*.

18

: :: : *proportion* The signs of proportion being placed between numbers or quantities are thus read, 8 : 16 : : 10 : 20, as 8 is to 16 so is 10 to 20; or $a : b :: c : d$, as a is to b so is c to d.

∵ *therefore* In mathematical operations the word *therefore* or *consequently* often occurs, to express which, the foregoing symbol is generally employed thus, $\because a+b=c+d$, is read, therefore $a+b$ is equal to $c+d$.

——— *vinculum* or (   ) *parenthesis* denotes that numbers or quantities having the former symbol drawn over them, or being enclosed by the latter, are to be considered as one quantity; thus $6\times\overline{4+8+12}$ or $6\,(4+8+12)$ signifies that 6 is to be multiplied by the sum of 4, 8, and 12; and $\overline{a\times b}.\overline{a-b}$, or $(a+b)\,.\,(a-b)$ denotes that the sum of a and b is to be multiplied by their difference.

° signifies *degrees*; thus 45° means 45 degrees.

′ signifies *minutes*; thus 30′ represent 30 minutes

″ signifies *seconds*; thus 15″ denotes 15 seconds.

∠ signifies *angle.*

△ signifies *triangle.*

∟ signifies *right angle*

⊿ signifies *right-angled triangle*

□ signifies *square.*

⊙ signifies the *sun.*

☽ signifies the *moon.*

⊙̄ signifies the *sun's upper limb.*

⊙̲ signifies the *sun's lower limb.*

☽̄ signifies the *moon's upper limb.*

☾̲ signifies the *moon's lower limb*

* signifies a *star.*

ABBREVIATIONS.

acc.	account	a.t.s.	apparent time at ship
alt.	altitude	ar. co.	arithmetical complement
a.m.	ante meridian	azm.	azimuth
amp.	amplitude	chro.	chronometer
app.	apparent	co.	complement
ap.alt.	apparent altitude	cos.	co-sine

cosec.	co-secant
cot.	co-tangent
cou.	course
dec.	declination
dep.	departure
diff.	difference
dist.	distance
d.r.	dead reckoning
G.	Greenwich
h.a.	hour angle
h.p.	horizontal parallax
int.	intermediate
lat.	latitude
log.	logarithm.—logarithmic
long.	longitude
lun. obs	lunar observation
mag.	magnetic
mer.	meridian
midn.	midnight
m.t.G.	mean time at Greenwich
m.t.s.	mean time at ship
N.A.	Nautical Almanac
obs.	observed.—observation
par.	parallax
p.d.	polar distance
p.l.	proportional logarithm
p.m.	post meridian
pro.	proportion.—proportional
pts.	parts.—points
r.a.	right ascension
sec.	secant
sin.	sine
semd.	semi-diameter
s.t.	sidereal time
T.	Table (in the present vol.)
tang.	tangent
T.T.	Taylor's Lunar Tables
z.d.	zenith dist
zen.	zenith
h. m. s.	hours minutes seconds

The words "the" and "of" are for the sake of brevity often omitted; thus—"To find *the* difference *of* Latitude," is written "To find *diff. Lat.*" "The meridian altitude of the Sun's lower limb," is written "Mer. Alt. $\underline{\odot}$" &c.

ARITHMETIC, &c.

IT is presumed, that pupils commencing the study of Navigation, are generally prepared in those branches of mathematics, of which Navigation is but the application ; and therefore it would be useless, as well as impossible in a work of the following description, to enter satisfactorily into the study of sciences, a competent knowledge of which, can only be obtained from works devoted exclusively to their investigation ; but there may be some who have not had the advantage of previous study, to whom the following preliminary information may be serviceable, as it may facilitate their progress in acquiring a knowledge of Practical Navigation.

DECIMAL ARITHMETIC.

If an unit be broken or divided into a certain number of equal parts, any number of those parts considered in relation to the whole, constitutes a fraction, which is commonly expressed by two numbers written one above the other, with a dash or line between them. The number below the line gives the *name* to the fraction, by shewing how many equal parts the unit is divided into, and is thence called the *denominator*. And the number above the line is called the *numerator;* because it enumerates or expresses the number of those parts contained in the fraction. Thus, if the unit be divided into seven equal parts, each part is denominated a *seventh;* and if four of those parts be taken, the fraction is four-sevenths, and is written thus $\frac{4}{7}$. Fractions thus expressed are termed *Vulgar Fractions,* and are either *proper* or *improper*. A proper fraction is a fraction whose denominator is greater than the numerator. An improper fraction is that in which the numerator is equal to, or greater than the denominator. The value of the former is therefore less, and that of the latter equal to, or greater than unity, or 1.

A fraction having for its denominator an unit with any number of ciphers annexed, is called a *Decimal* Fraction, as $\frac{1}{10}$, $\frac{4}{100}$, $\frac{15}{1000}$, &c. It is, however, more usually, and more conveniently expressed by setting down the numerator only, with a point before it on the left-hand, carefully observing that the numerator thus expressed, must always consist of as many figures as there are ciphers in the denominator; and if it has not so many, the deficiency must be supplied by placing ciphers before it, thus $\frac{75}{10000}$ is written ·0075. &c.

A mixed number is composed of a whole number and a fraction, either vulgar or decimal, thus $5\frac{75}{100}$, or 5·75, signifies the same thing, viz.: 5 whole units and 75 one-hundredth parts of an unit;—the fractional part in the latter form being separated from the integral by a dot, called the decimal point. Ciphers on the left-hand of integers, or on the right hand of fractions, do not alter their value; but when ciphers are placed on the left hand of a decimal, they decrease its value in a ten-fold proportion; thus, ·5 is $\frac{5}{10}$, or 5-tenths, but ·05 is only $\frac{5}{100}$, or 5-hundredths, ·005 is only $\frac{5}{1000}$, or 5-thousandths, &c. Hence it is obvious, that in decimals, as well as in whole numbers, the value of the place of the figure increases towards the left-hand, and decreases towards the right in the same tenfold proportion.

ADDITION OF DECIMALS.

Addition of decimals is performed exactly like that of whole numbers, observing to place the quantities so that the decimal point may be in the same vertical line, in which case numbers of the same denomination will stand immediately under one another.

Examples.

Add together 27·5, 456, ·328, 7·04, and 37·86.

```
         27·5
        456·
           ·328
          7·04
         37·86
       --------
Sum .... 528·728
```

Add together 5·96, 205·4, 70, 59·6, and ·007.

```
   5·96
 205·4
  70·
  59·6
    ·007
 -------
 340·967
```

SUBTRACTION OF DECIMALS.

Subtraction of decimals is likewise performed as in whole numbers, observing, as before, to range the numbers of the same denomination, and the decimal points, directly under each other.

Examples,

From 768·1404 take 36·571,

```
             768·1404
              36·571
             --------
Remainder .... 731·5694
```

From 365 take ·46072,

```
         365
            ·46072
        ----------
Rem. ... 364·53928
```

From 24·0617 take 12·759,

24·0617
12·759

Rem..... 11·3027

From 807·1 take 507·0065,

807·1
507·0065

Rem... 300·0935

MULTIPLICATION OF DECIMALS.

Make that term which consists of the fewer figures the multiplier, and placing it under the other (without regarding whether the decimal points fall under each other or not); multiply them together as in whole numbers, observing to point off as many decimals in the product, counting from the right-hand, as there are decimal places in both factors; should it happen that there are not so many figures in the product as the number of fractional places required, prefix as many cyphers on the left-hand as will supply the defect.

Examples,

Multiply together 40·76 and 3·75

40·76 multiplicand
3·75 multiplier

20380
28532
12228

152·8500 product

Multiply together ·5078 and ·0684,

·5078 multiplicand
·0684 multiplier

20312
40624
30468

·03473352 product

DIVISION OF DECIMALS.

Divide as in whole numbers, observing to point off as many decimal places in the quotient, as the decimal places in the dividend exceed those in the divisor. If there be not as many figures in the quotient as are equal to that excess, supply the deficiency by prefixing ciphers, and place the decimal point before them, If the dividend have just the same number of decimals as the divisor, the quotient will be a whole number, without any decimal places. When the decimal places in the divisor exceed those in the dividend, or when there happens to be a remainder after the division, then ciphers may be annexed, and the operation continued as far as may be deemed necessary.

Examples,

Divide 378·5611 by ·4568,

Divisor. Dividend. Quotient.
·4568) 378·5611 (828
36544
13121
9136
39851
36544
3307

Divide 126·670 by 478,

Divisor. Dividend. Quotient.
478) 126·670 (·265
956
3107
2868
2390
2390
....

Divide 4·1472 by 54

Divisor. Dividend. Quotient.

54) 4·1472 (·0768
378

367
324

432
432

Divide 5 by 18,

Divisor. Dividend. Quotient.

18) 5·0 (·277 &c.
36

140
126

140
126

14 &c.

REDUCTION OF DECIMALS.

To reduce a Vulgar Fraction to a Decimal Fraction of equal value.

Rule.—Divide the numerator with a cipher or ciphers annexed, by the denominator, and the quotient will be the required decimal. It will however, in most cases, be sufficient to understand the ciphers to be so annexed, without actually expressing them.

Examples,

Reduce $\frac{1}{4}$, $\frac{1}{2}$, $\frac{3}{4}$, and $\frac{7}{8}$, to equivalent decimal fractions.

4) 1·0	2) 1	4) 3	8) 7
·25	·5	·75	·875

To reduce a number consisting of one or more denominations, to a decimal fraction of a higher denomination.

Rule.—If the given number consist of but one denomination, consider it as a fraction of a higher denomination of the same kind of quantity; as, a second the $\frac{1}{60}$ of a minute, a league the $\frac{1}{20}$ of a degree, and so on, then find the equivalent decimal by the foregoing rule.

Examples,

Reduce 45 miles to the decimal of a degree.

60) 45

·75 Answer

Reduce 15 minutes to the decimal of an hour.

60) 15

·25 Answer.

If the given number consist of several denominations, to bring it to a decimal of its greatest name, write the several denominations orderly one under another, commencing with the *lowest* denomination, and let these be considered as dividends, and on their left draw a perpendicular line. Against each of the foregoing denominations on the other side of the line, write the number of the less denomination that makes one of the next greater, and let these stand as divisors to the former dividends. Divid each dividend by its respective divisor, commencing at the top, and se the quotient arising from each operation as fractions, on the right of th dividend immediately below it. Let this mixed number be divided b its divisor, placing the quotient as before, and so on, till each dividen has been divided by its respective divisor, and the last quotient will b the decimal fraction sought.

Examples,

Reduce 12 leagues 2 miles 7 furlongs to the decimal.

8	7
3	2·875
20	12·9583333 &c.
	·6479166 &c.

Reduce 4h. 10m. 50s. to the de cimal of a day.

60	50
60	10·8333 &c.
24	4·18055 &c.
	·17419 ×

To find the value of a decimal fraction of a superior denomination, in part of the integer of inferior denominations.

Rule.—Multiply the given decimal by the number of parts contained in the next inferior denomination, pointing off from the right-hand of the product so many figures for decimals as the given decimal consists of. Multiply the figures so pointed off by the number of parts contained in the next inferior denomination, and from the result cut off the decimal places as before: proceed thus till the least known or required parts of the integer are brought out; then the several denominations on the left-hand of the decimal points, will express the value of the given decimal fraction.

Examples,

Required the value of ·745 of an hour.

	·745
	60
Minutes	44·700
	60
Seconds	42·000

Or more briefly,

	·745
	60
Minutes	44·7|00
	60
Seconds	42·

Hence the required value is 44m. 42s.

Required the value of ·46795 of a degree.

·46795
60

Minutes 28·077|00
60

Seconds 4·62|0
60

Thirds 37·20

Hence the required value is 28′ 4″ 37·2‴

THE RULE OF THREE IN DECIMALS.

If the terms consist of several denominations, the inferior parts are to be reduced to decimals of the highest denomination mentioned, by the preceding rules. Then state the question, and proceed as in the common Rule of Three Direct; that is, place the numbers in such order, that the first and third terms may be of the same kind, and the second the same as the number required.

Multiply the second and third terms together, and divide the product by the first term, then the quotient will be the answer in the same denomination as the second term, observing to point off the decimal places according to the directions already given.

Examples.

If a chronometer lose 1·75s. per day, what is its loss in 14h. 30m.?

14h. 30m. = 14·5 h.

24 : 1·75 :: 14·5
14·5

875
700
175

s.
24) 25·375 (1·057 Answer
24

137
120

175
168

7

If ¾ of a ship cost £740. 10s, what will ⅝ of her be worth?

¾ = ·75
⅝ = ·625
£
740 10 = 740·5

£
·75 : 740·5 :: ·625
·625

37025
14810
44430

£
·75)462·8125(617·08+
450

128
75

531
525

625
600

25

·08
20

s. 1·60
12

d. 7·20
4

80

Therefore ⅝ is worth £617. 1s. 7¼d. nearly.

LOGARITHMS.

Logarithms are a series of numbers designed to abridge elaborate calculations in arithmetic, and were originally invented by Baron Napier, for the purpose of facilitating computations in plane and spherical trigonometry. By means of these artificial numbers, the operation of multiplication may be performed by addition, and division by subtraction; numbers may be involved to any power by simple multiplication, and the root of any power may be extracted by division only.

MULTIPLICATION.

Rule.—Add the logarithms of the factors * together (T.4.) and the natural number answering to the sum will be the product sought. If either or both of the factors should consist wholly of decimals, and the index of the sum exceed 10, reject the 10, and the remainder will be the index of the logarithm answering to the product.

Examples.

Required the product of 76 and 48

Log. of 76 = 1·88081
Log. of 48 = 1·68124
Product 3648 = Log. 3·56205

Required the product of ·82 by ·065

Log. of ·82 = 9·91381
Log. of ·065 = 8·81291
Product ·0533 = Log. 8·72672

Required the product of 176·5 and 5·5.

Log. of 176·5 = 2·24675
Log. of 5·5 = 0·74036
Product 970·8 = Log. 2·98711

Required the product of 734 by 19.

Log. of 734 = 2·86570
Log. of 19 = 1·27875
Product 13946 = Log. 4·14445

DIVISION.

Rule.—From the logarithm of the dividend subtract the logarithm of the divisor, and the remainder will be the logarithm of the quotient. If the logarithm of the divisor be greater than that of the dividend, increase the index of the latter by 10.

Examples.

Divide 9052 by 62.

Log of 9052 = 3·95675
Log. of 62 = 1·79239
Quotient 146 = Log. 2·16436

Divide ·06099 by ·19.

Log. of ·06099 = 8·78526
Log. of ·19 = 9·27875
Quotient ·321 = Log. 9·50651

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* For the method of taking out the logarithms see explanation to Table 4.

RULE OF THREE.

Rule 1.—Add together the logarithms of the second and third terms, and from their sum subtract the logarithm of the first term, the remainder will be the logarithm of the fourth term.

Rule 2.—Add together the arithmetical complement of the logarithm of the first term and the logarithms of the second and third terms, their sum, rejecting 10 in the index, will be the logarithm of the fourth term.

In stating questions in this rule, it will obviously be more convenient to range the terms one under another, in a vertical column, than to place them in a horizontal line, as in common arithmetic.

Examples.

If a chronometer gain 1·75s. in a day, what is its gain in 14·5h ?

By Rule 1.

As	24h.	log.	1·38021
:	1·75s.	log.	0·24304
::	14·5h.	log.	1·16137
			1·40441
			1·38021
:	1·057s.	log.	0·02420

By Rule 2.

As	24h. arith. co.	log.	8·61979
:	1·75s.	log.	0·24304
::	14·5	log.	1·16137
:	1·057	log.	0·02420

What is the worth of ⅝ of a ship, ¾ of which cost £740 10s ?

⅝ = ·625 ¾ = ·75 £740 10s. = £740. 5

By Rule 1.

As	·75	log.	9·87506
:	740·5	log.	2·86953
::	·625	log.	9·79588
			12·66541
			9·87506
:	£617·1	log.	2·79035

By Rule 2.

As	75 arith, co.	log.	0·12494
:	740·5	log.	2·86953
::	·625	log.	9·79581
:	£617·1	log.	2·79035

PRACTICAL GEOMETRY.

DEFINITIONS.

GEOMETRY, derived from the Greek words, signifying *the art of measuring the Earth,* is that branch of Mathematics which treats of the magnitudes of dimensions, as, for instance, of lines, angles, surfaces, and solids.

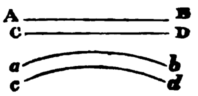
A point, (•) is that which has position, but no magnitude, nor dimensions, neither length, breadth, nor thickness.

A line, is length without breadth or thickness.

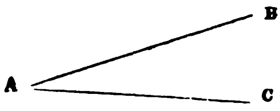
A straight line, or *right line,* is that which lies evenly between its extreme points; or, as defined by Archimedes, it is the shortest distance between two points, as A B.

A curve line, is a line that continually changes its direction between its extreme points, as C D.

Parallel lines are always at the same perpendicular distance from each other, and consequently never meet though produced *ad infinitum;* as AB and CD, or *ab* and *cd.*



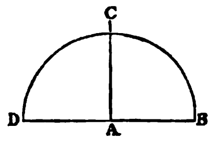
A rectilinear angle is the inclination of two straight lines to one another, and meeting in a point called the angular point, or the vertex of the angle, and the lines themselves are called the legs, as AB, or AC.



When more angles than one meet at the same point, any one of them is expressed by three letters, of which the letter at the vertex or point in which the straight lines meet, is placed between the other two letters. If there be only one angle at the point, it may also be so expressed; but it is more common in the latter case, to express the angle by that letter only which is at the vertex of the angle. Thus, the angle in the annexed figure may be called the angle BAC, or simply the angle A.

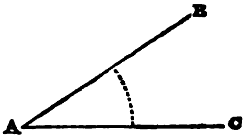
An angle is measured by an arc of a circle described about the angular point as a centre, the value of the angle being estimated by the number of degrees, minutes, and seconds, or points and quarter-points of the compass, cut off from the circle by the lines which form the angle.

When a straight line standing on another straight line makes the adjacent angles equal to one another, each of the angles is called a *right angle,* and the straight line which stands on the other is called a perpendicular to it: thus the line AC is perpendicular to DB, and makes with it the two adjacent angles CAD, CAB, equal to one another, each being a right angle containing 90° or 8 points.

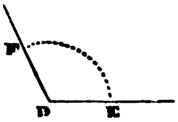


Each of the figures into which the semi-circle, DCB, is divided by the line AC, is called a *quadrant,* being a quarter of a circle.

An acute angle is that which is less than a right angle, or 90°, as BAC.



An obtuse angle is that which is greater than a right angle, as FDE.

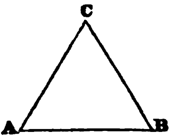


Rectilinear figures are those which are contained by right lines.

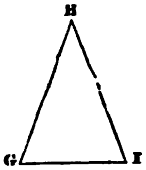
The smallest number of right lines that can include a space is three.

A figure formed by three right lines is called a trilateral figure, or triangle, and it consists of six parts, viz. three sides and three angles.

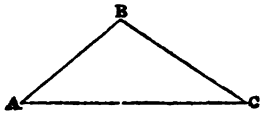
Triangles are of various kinds, and are named according to the relative length of their sides, or the magnitude of their angles. An equilateral triangle is that which has three equal sides, ABC.



An isosceles triangle is that which has only two equal sides, as GHI.

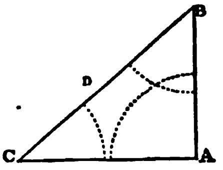


A scalene triangle is that which has three unequal sides, as CAB.

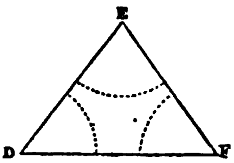


A right-angled triangle is that which has one right angle, as BAC.

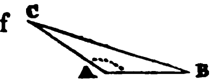
In a right-angled triangle, the side oppposite to the right angle is called the *hypothenuse*, as D. The other two sides are called the *legs*; that which is upright is called the *perpendicular*, as AB; and the horizontal line, as AC, is denominated the *base*.



An acute-angled triangle has all its three angles acute, as DEF.

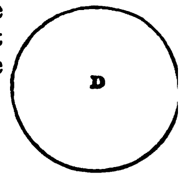


An obtuse-angled triangle is that which has one of its angles obtuse, as the angle A, in the triangle ABC.



A circle is a plane figure bounded by a regular curve line, called the circumference or periphery, every point of which is equi-distant from a certain point within the figure, called the centre, as D.

The circumference itself is often called a circle.

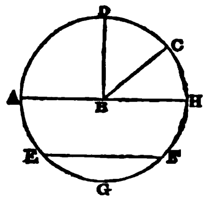


The circumference of every circle is conceived to be divided into 360 equal parts called degrees; and each degree into 60 equal parts called minutes; each minute into 60 equal parts called seconds; and each second into 60 equal parts called thirds.

The circumference of the circle is also divided into 32 equal parts called points of the compass, each containing 11° 15′; and these points are again divided each into 4 equal parts called quarter points.

The *diameter* of a circle is a straight line, as ABH, drawn through the centre of the circle and terminated each way by the circumference.

A semicircle is the figure contained by a diameter and the part of the circumference cut off by the diameter, as ADH, or AGH. The half circumference contains 180°. The *radius* of a circle is a straight line drawn from the centre of the circle to the circumference, as BD.



An *arc* of a circle is any portion of its circumference greater or less than a half, as EDF, or EGF.

A chord is a right line, as EF, joining the extremities of an arc, and dividing the circle into two parts. The chord is also sometimes called the subtense of an arch or arc.

A segment of a circle is a figure contained by a chord and the arc of the circle it cuts off, as EGF.

Similar figures are those which have all the angles of the one equal to all the angles of the other, and the corresponding sides about the angles of each figure, homologous, or similarly situated.

The perimeter of a figure is the sum of all its sides.

A problem is an operation proposed to be done.

A theorem is a truth proposed to be demonstrated.

A lemma is a preparatory proposition to render what follows more easy.

A corollary is a consequent truth, immediately deduced from some preceding demonstration.

A scholium is a remark made upon something going before it.

An axiom is a self evident truth.

A postulate is a request to admit the possibility of performing a certain simple operation.

A proposition is a general term signifying either a problem or a theorem.

AXIOMS.

1. Things which are equal to the same thing, are equal to each other.
2. When equals are added to equals, the wholes are equal.
3. When equals are taken from equals, the remainders are equal
4. When equals are added to unequals, the wholes are unequal.
5. When equals are taken from unequals, the remainders are unequal.
6. Things which are like multiples of the same, or of equal things, are equal to each other.
7. Things which are like parts of the same, or of equal things, are equal to each other.
8. The whole of any thing is equal to the sum of all its parts.
9. The whole of any thing is greater than a part of it.
10. Magnitudes which coincide with one another, or fill the same space, are identical or mutually equal in all respects.
11. All right angles are equal to one another.
12. If two straight lines are parallel to each other, a line which meets one of them will, if produced, meet the other.
13. If two straight lines intersect each other, they cannot both be parallel to the same straight line.

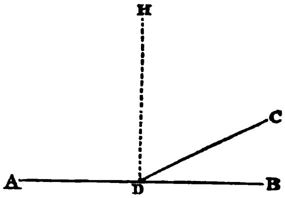
POSTULATES.

1. Let it be granted that a straight line may be drawn from any one point to any other point.
2. That a straight line may be produced to any length in the same direction.
3. That a circle may be described round any point as a centre, and with any radius.

THEOREMS.

Theorem I. [Euclid i. 13.]

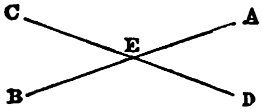
If one line falls on another the angles it makes with it are either two right angles, or are together equal to two right angles.



Let AB meet the line DC, then the angles CDB CDA taken together are equal to two right angles. For let DH be perpendicular to AB, the angles ADH, HDB, are equal and right angles; but the angle ADC is greater, and the angle CDB less by the ∠ HDC, than a right angle; therefore if the angle HDC were added to the angle CDB, or subtracted from CDA, the angle HDB, in the first case, or HDA in the other, would be a right angle; therefore the angles CDB and CDA are together equal to two right angles. QED.

Theorem II. [Eu. i. 15.]

Two straight lines, as AB, DC, *intersecting each other at the point* E *make the vertical or opposite angles equal.*

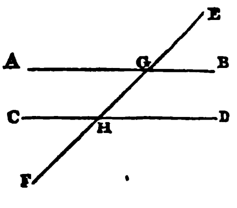


The angle CEA is equal to the angle BED, likewise the angle CEB is equal to the angle AED; for by Theo. I. [Eu. i. 13.] the angles, CEB, BED are equal to two right angles, and in like manner the angles AED, BED taken together are equal to two right angles; take away the common angle BED, and the angle CEB will be equal to the angle AED.

Again, the angles AEC, CEB are equal to two right angles, and are therefore equal to the angles CEB, BED; take away the common angle CEB, and the angle AEC will be equal to the angle BED. Quod érat demonstrandum.

Theorem III. [Eu. i. 29.]

When a line falls on two parallel lines, it makes the alternate angles equal, and the angles at the same side of one line equal those on the same side of the other.



Let the line EF cut the two parallel lines AB DC, then will the outward angle EGB, be equal to the inward opposite angle GHD, on the same side of the line EF; and the two inward angles BGH GHD, taken together, will be equal to two right angles.

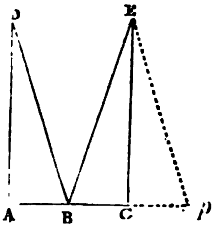
We must first prove the alternate angles equal thus :—Since the two lines are parallel, the alternate angles AGH, GHD, as well as the other alternate angles BGH, GHC, must be equal; for if the angle AGH be not equal to GHD, it must be either greater or less than it: if greater AGH would be the exterior angle, and GHD, the interior angle of a triangle [Eu. i. 16.], and AB and CD, produced through the points B and D, should meet and form two sides of this triangle; but AB, CD cannot meet, because they are parallel: hence AGH is not greater than GHD, neither can it be less, for in this case, AB and CD, if produced through the points A and C would at length meet, which is equally against the hypothesis. Wherefore the angle AGH is neither greater than GHD, nor less than it; it must therefore be equal to it: hence the alternate angles are equal.

Again, since the angle AGH is equal to the alternate angle GHD, and the angle AGH is equal to the opposite angle EGB; therefore the angle EGB, is also equal to the angle GHD. Q.E.D.

Theorem IV. [Eu. i. 8.]

If of any two triangles the three sides of the one are equal to the three sides of the other, the triangles are equal and their angles equal.

Let the perpendicular AD=EC, the base AB=BC, and DB=BE, then by placing the triangle BEC on the triangle ADB, the sides and angles will coincide with each other and be equal.



Theorem V. [Eu. i. 5,]

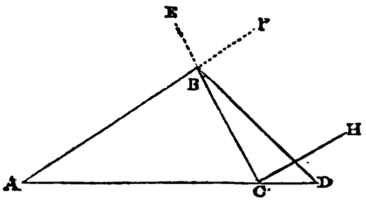
In an isosceles triangle the angles at the base are equal; or, if a triangle have two sides equal, their opposite angles are also equal.

If the triangle BE*p* have the side BE, equal to E*p*, then the angle at B will be equal to the angle at *p* An isosceles triangle formed by two equal and similar triangles, as BEC CE*p* will have two sides, and the contained angle of the one equal to the two sides and contained angle of the other; as the side BE=E*p*, and the angle BEC=*p* EC, and the side EC common. (See the preceding figure.)

Theorem VI. [Eu. i. 16.]

When one side of a triangle is produced, the outward angle is greater than either of the two inward opposite angles.

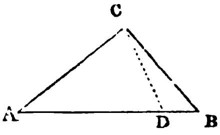
In the triangle ABC let the side AC be produced to D, then the angle BCD is greater than the angles A or B, for draw CH parallel to AB, then



the angle HCD will be equal to BAC, by Theorem III, [Eu. i. 29.] and if CB and AB be produced to E and F, the angle BCH will be equal to EBF; but the angle EBF is equal to the angle ABC, by Theo. II. [Eu. i. 15.] therefore the angle BCD is equal to the angles BAC ABC, consequently must be greater than either singly: Q.E.D. This proves in part [Eu. i. 32.] also.

Theorem VII. [Eu. i. 18 and 19.]

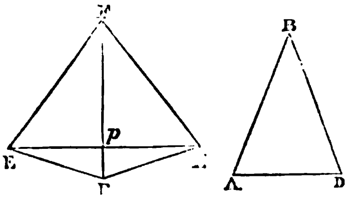
The greater side in any triangle subtends the greater angle, and vice versa.



Let ABC be a triangle having the side AB greater than the side AC, then will the angle ACB, opposite the greater side AB, be greater than the angle B opposite the less side AC; for on the greater side AB, take the part AD equal to the less side AC, and join DC; then it is evident the angle ACB is greater than ACD by the angle DCB. But ACD=ADC Theo V. [Eu. i 5.] and ADC is greater than ABC, [Eu. i. 16.] much more then is ACB greater than ABC. The same may be observed of the sides AC and CB, and the angles ABC, BAC. Q.E.D.

Theorem VIII. [Eu. i. 24.]

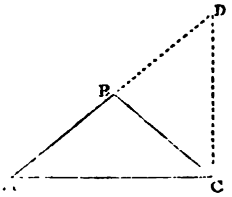
If two triangles have two sides of the one equal to two sides of the other, but the included angle of the one greater than the included angle of the other, then the side opposite the greater angle will be greater than the side opposite the less angle.



Let ABD and EFH be two triangles, having the sides AB BD equal to the sides EF, FH, and the angle EFH greater than the angle ADB, then the side EH is greater than the side AD; for let the angle ABD=FBH, the angle BFH will be less than the angle EFH, by the angle EFB, join EB, then the angle FBE (=FEB) [*Eu.* i. 5.] is greater than BEH; much more is HBE greater than BEH, therefore by [Eu. i. 19.] the base EH is greater than BH, or AD. Q.E.D.

Theorem IX. [Eu. i. 20.]

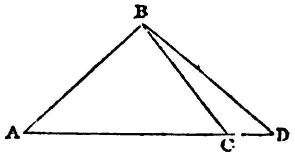
In any triangle the sum of any two sides is greater than the third, as in the triangle ABC.



AB BC together are greater than AC, for produce AB to D, and make BC equal BD, then AD will be equal to the sum of the two sides AB BC; and, [Eu. i. 5.] the angles BCD BDC are equal, therefore the whole angle ACD is greater than the angle BDC, and, [Eu. i. 19.] AD is greater than AC. Q.E.D.

Theorem X. [Eu. i. 32.]

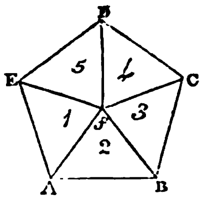
In any triangle the sum of the three angles is equal to two right angles.



For in the triangle ABC, let AC be produced to D, the angle BCD, by Theorem VI, will be equal to the angles at A and B, and [Eu. i. 13] the angles BCD+BCA are equal to two right angles, therefore ABC+BAC+BCA, are together equal to two right angles.

Theorem XI. [Eu. i. 32. Cor. 1.]

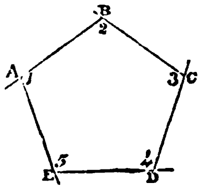
In any figure whatever, the sum of all the inward angles taken together, is equal to twice as many right angles, wanting four, as the figure has sides.



Let ABCDE be any figure, the sum of all its inward angles at ABCDE is equal to ten right angles wanting four right angles; for if five triangles be constructed on this figure towards the centre, each triangle will be equal to two right angles, by [Eu. i. 32.], and by [Eu. i. 15.], all the angles at the centre *f* are equal to four right angles, therefore the five inward angles ABCDE, want the four right angles at the centre *f* to make up ten right angles, that is, twice as many right angles as the figure has sides.

Theorem XII. [Eu. i. 32. Cor. ii.]

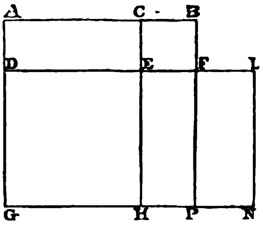
In any figure when every side is produced out, the sum of all the outward angles is equal to four right angles.



Let the outward angles be denoted by ABCDE, and the interior angles by 12345, then [Eu. i. 13.] each of the outward with its inward angle, is equal to two right angles, being the two angles made by one line meeting another. The sum of all the outward and inward angles, is equal to twice as many right angles as the figure has sides; but the sum of all the inward angles is equal to twice as many right angles as the figure has sides, wanting four right angles;—therefore the sum of all the outward angles is equal to four right angles. [Ax. i.]

Theorem XIII. [Eu. ii. 4.]

The square of a whole line is equal to the sum of the squares of its two parts, together will twice the rectangle of those parts.



Let ABGP be the square on the line AB, which line divide in the point C. The squares of AC and CB together, with twice the rectangle AC and CB, are equal to the square ABPG, for from the point C draw the line CH parallel to BP; and again, make BF equal to CB, and draw ED parallel to AB; then DE will be equal to AC or to GH, and also to each of the lines, DG, EH, FP, and also CB to EF, CE or BF, then CBEF will be the square of one of the parts, and DEHG the square of the other part. Also the parallelogram EFPH, equal to ACED, [Eu. i. 43.] both together being twice the rectangle of the two parts; add the square of CB, and the sum will equal the square of AB. Or thus: let one of the parts be x the other y, then $x+y$ squared will be $x^2+2xy+y^2$, equal to the square of the whole line.

Theorem XIV. [Cor. Eu. ii. 4.]

The square of the difference of two lines, is less than the sum of their squares, by twice the rectangle of the said lines. (See the last figure.)

Let AB and CB be the two lines, DEGH the square of AC=the difference of the lines, and CBEF the square of the other line CB; now if the square of their difference, which is DEGH be taken away, it will leave the rectangular parallellograms AE, EP, plus twice the square of BC, that is the rectangle AB, BC. Or thus: let one line be x, the other y; what is the square of their difference? $x—y$ squared, gives $x^2+y^2—2xy$, as before.

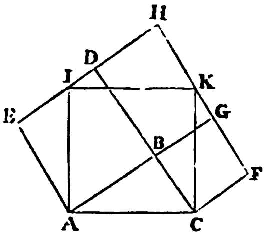
Theorem XV. [Eu. ii. 5. Cor.]

The difference of the squares of any two right lines is equal to the rectangle of their sum and difference. (See figure in Theorem xiii.)

Let AB, CB be the two lines, then AC is their difference; and the square of AB, less the square of CB is equal to the rectangle contained under AB+BC and AC (their sum and difference), for the parallelogram DLGN is the rectangle contained by their sum and difference and the parallelogram FN is equal to EP, for BF is equal to FL and FP to AC; Or thus, let one line be x the other y then $x+y\times x—y=x^2—y^2$

Theorem XVI. [Eu. 1. 47.]

The square of the hypothenuse or side subtending the right angle of any right-angled triangle, is equal to the sum of the squares of the two legs, or sides containing the right angle.

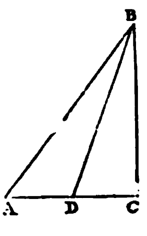


Let ABC be the right angled triangle of which the angle ABC is the right angle; describe squares upon the two sides AB BC as in the diagram; the figure AIKC upon the side AC, is also a square, and equal to the sum of the squares ABDE and BCFG, upon the sides AB and BC. That AK is a square may be thus proved. At the extremities of the hypothenuse AC, draw the perpendiculars AI and CK meeting ED in I and FG produced in K, and join IK:—the angles BAE and CAI are right angles, take away the common angle BAI, and the angles CAB and IAE will be equal: the side BA is equal to AE, therefore by (Eu. i. 26.) the triangles BAC, IAE are equal, and IA equal AC. In like manner CK = AC; IA and CK are therefore equal and parallel, whence AC and IK are equal and parallel. (Eu. i. 33.) and AIKC, or AK is a square. The triangle IHK also is equal to ABC; wherefore the three external triangles are equal. Now if these three triangles be taken from the whole figure, the square AK will be left, and if the original triangle ABC together with the rectangle BH, which is its double, be taken from the same figure, there will be left the two squares AD and CG which are, therefore, together equal to the square AK. Q.E.D.

Corollary.—The difference of the squares of the hypothenuse and either of the legs is equal to the square of the other leg; by Theorem XV, the product of the sum and difference of the hypothenuse and either of the legs, is equal to the square of the other leg. Q.E.D.

Theorem XVII. [Eu. ii. 12.]

In any obtuse angled triangle, the square of the side subtending the obtuse angle, is greater than the sum of the squares of the other two sides, by twice the rectangle of the base, and the distance of the perpendicular from the obtuse angle.

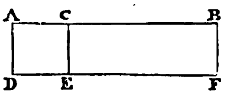


Let ABC be a right angled triangle, and BD a line drawn from the vertical angle B, cutting the base into two segments AD DC, then will ADB be an obtuse angled triangle, because the angle ADB is greater than the angle ACB [Eu. i. 16.] that is than a right angle; and the square of AB is greater than the squares of AD DB, by twice the rectangle AD DC, for by Theorem XVI. [Eu. i. 47.] the square of AB is equal to the squares AC CB and by [Eu. ii. 4.] the square of AC is equal to the squares of AD DC, together with twice the rectangle AD DC, hence the square of AB is equal to the squares of AD DC and CB, together with twice the rectangle of AD DC; but the squares of DC CB, by Theorem XVI. [Eu. i. 47.] are equal to the square of DB; hence the square of AB is equal to the squares of AD DB, more twice the rectangle of AD DC. Therefore the square of AB is greater than the squares of AD DC, by twice the rectangles of AD DC. Q.E.D.

Corollary—The square of AB, less the squares of AD DC, divided by twice AD, is equal to DC; and the square of BD, less the square of DC = the square of BC; hence the three sides being given, the perpendicular is given.

Theorem XVIII. [Eu. ii. 3.]

If a straight line be divided into two parts, the rectangle of the whole line and one of the parts will be equal to the square of the same part, and the rectangle contained by the two parts.

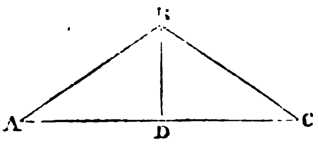


Let the straight line be AB divided at C, then the rectangle AB AC, is equal to the square of AC, and the rectangle contained by AC and CB; for make AD equal to AC, by a perpendicular let fall from A, and draw DF parallel to AB. Again, draw CE parallel to AD, then AB DF will be the rectangle contained by AC BA; likewise AC DE is a square on one of the parts, and CEBF is the rectangle contained by the two parts AC CB, which are equal to AD BF; or if one of the parts be x the other y, the two parts will be $x+y=$ the whole line, and if multiplied by one of the parts, suppose x, it will be $x+y\times x=x^2+xy$.

Corollary.—Twice the whole line multiplied by one of the parts, will be equal to twice the square of that part, more twice the same part multiplied by the other part; thus, the whole line being $x+y\times 2=2x+2y\times x=2x^2+2xy$.

Theorem XIX.

In any triangle if a perpendicular be let fall from the vertical angle on the base, cutting it into two segments, the square of the side opposite an acute angle, is less than the squares of the other two sides by twice the rectangle of the base, and the segment between the perpendicular and the acute angle.

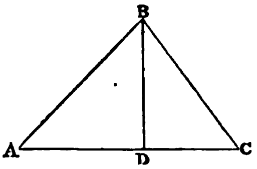


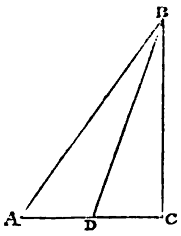
Let ABC be the triangle, and the perpendicular let fall be BD, then the square of AB is less than the squares of BC and AC, by twice the rectangle of AC and DC, for by Theorem XIII. [Eu. ii. 4.] the square of AC is equal to the squares of AD

DC and twice the rectangle AD DC: add the square of DC to both, then will the squares of AC CD be equal to the square of AD and twice the square of DC, together with twice the rectangle AD, DC; but twice the rectangle AD, DC, together with twice the square of DC equal twice the rectangle AC CD, [Eu. ii. 3.]: hence the squares of AC CD = the square of AD, and twice the rectangle AC CD: to both sides add the square of BD, and the squares of AC CD BD (= the squares of AC BC.) = the squares of AD DB, or the square of AB, together with twice the rectangle AC CD, therefore the square of AB is less than the squares of AC BC by twice the rectangle AC CD. Q.E.D.

Theorem XX.

In any triangle, if a perpendicular be let fall from the vertical angle on the base, the difference of the squares of the segments of the base, is equal to the difference of the squares of the two sides.





The square of AB is equal to the squares of BD and AD by Theorem XVI. [Eu. i. 47.] and the square of BC is equal to the squares of BD DC hence the difference of the squares AB BC, is equal to the difference between the sum of the squares AD DB, and the sum of the squares CD DB; then take away the common square DB, and the difference of the squares AB BC, is equal to the difference of the squares AD DC. Q.E.D.

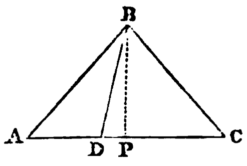
Corollary 1st.—By Theorem XV. (Cor. ii. 5.) the rectangle of the sum and difference of the two sides, is equal to the rectangle of the sum and difference of the segments of the base.

Corollary 2nd.—When the perpendicular falls without the triangle, as in figure 2nd, the rectangle of the sum and difference of the two sides, is equal to the rectangle of the sum of the two segments AC CD and their difference AD.

Theorem XXI.

If the base of a triangle be bisected by a right line, drawn from the vertical angle, the sum of the squares of that line and half the base, will be equal to half the sum of the squares of the other sides of the triangle.

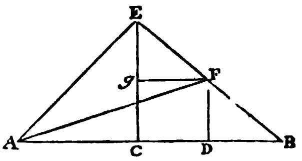
In the triangle ABC, let the line DB bisect the base at the point D; let fall a perpendicular line from the point B, on the base AC, which

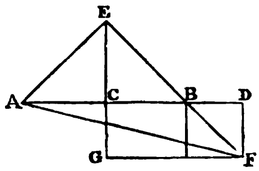


falls at P, then by Corollary 2nd, Theorem XX, AB squared = BD squared, more AD squared, more twice the rectangle AD DP; and by Theorem XX, BC squared = BD squared, more CB squared, less twice the rectangle AD DP; hence AB squared more BC squared, is equal twice BD squared more twice AD squared. Q.E.D.

Theorem XXII. [Eu. ii. 9 & 10.]

If any straight line be bisected, and any other point be taken on it, or the line be produced to another point, in the first case the squares of the unequal parts will be double the squares of half the line, and that of the intermediate segment; and in the second, the square of the whole line produced, and of the part produced, will be double the squares of half the line and of the line made up of the half and the part produced.



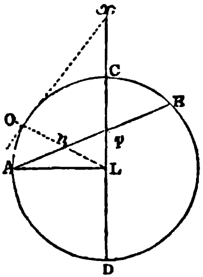


Suppose the right line AB bisected in the point C, and again divided into two unequal parts in the point D; either in the line AB, or AB produced to the point D, as in the second figure; then the squares of AD and BD are double the squares of AC and CD; for draw the perpendicular CE, and make it equal to AC; then by Theorem XVII, [Eu. i. 47.] the square of AE is equal to double the square of AC = half AB, and by the same, the square of EF is double that of CD, (the intermediate distance) therefore as the square of EF is equal to double the square of CD, and the square of AE double the square of AC, (half the line AB,) then by Theorem XVI. [Eu. i. 47.] the square of AF is equal to the squares of AE and EF, or to the squares of AD FD; but FD = DB, because the angle FDB is a right angle, and the angles at F and B are half right angles, Therefore the squares of AD DB, (being equal to the square of AF) are double the squares of AC CD. Q.E.D.

Theorem XXIII. [Eu. iii. 35.]

If any two lines intersect each other in a circle, the rectangles of their segments are equal.

Let AB CD intersect each other within the circle in the point p, then the rectangles Ap pB and Cp pD are equal; to simplify and make this more clear, let one of the lines be the diameter of the circle = CB and let the other AB cut it in p, then CL will be half CD, and pL LD two



segments; bisect AB at *n*, and A*n* *np* will be two segments, then join AL, which = LD, or radius, and you have constructed the triangle A*p*L; then by Theorem XXI. the difference of the squares of AL L*p*, will be equal to the difference of the squares of A*n* *np*; but the difference of the squares of any two lines, is equal to the rectangle of their sum and difference, by Theorem XV. (Eu. ii. 5. Cor.) therefore as DL is = LC, *p*C is the difference and D*p* their sum, = DL + L*p*; therefore C*p* × *p*D is = the difference of their squares, = the difference of the squares *p*L AL; but *p*B is the difference of the segments A*n* *np*, then *p*B × *p*A is equal to the difference of the squares of A*n* *np*; and consequently the rectangle OP PD = the rectangle BP PA. Q.E.D.

Corollary.—If the point of meeting falls without the circle at *x*, the rectangle *x*C *x*D is equal to the square of *x*O, for *x*O is a tangent and always perpendicular to the radius; therefore the triangle *x*OL is a right angled triangle, the right angle at *o*; hence the difference of the squares of OL *x*L is equal to the square of *x*O, but the difference of the squares of *x*L OL, is equal to the rectangle of *x*D *x*C. Q.E.D.

GEOMETRICAL PROPORTIONS.

Theorem A.

If four quantities are proportional, the rectangle of the extremes is equal to that of the means. Let a : b :: x : y, then a × y = b × x. [Eu. vi. 16.]

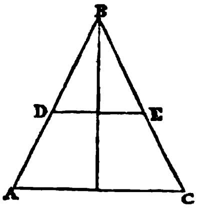
Theorem B.

If three be proportional, the rectangle of the extremes is equal to the square of the mean. Let a : b :: b : y, then a × y = b × b = (b^2). [Eu. vi. 17.]

Theorem C.

If there be two sets of proportionals, then the products or rectangles of the corresponding terms will also be proportional. Let
a : b :: x : y
c : d :: p : v
then ac : bd :: xp : yv.

Theorem D. [Eu. vi. 2.]

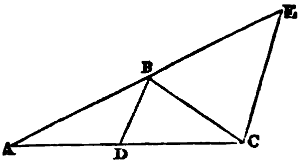


If a line be drawn parallel to any of the sides of a triangle, it cuts the two other sides proportionally, and also the triangle into two equi-angular triangles. Suppose the triangle ABC; let the line DE be parallel to the side AC, then the triangle DBE is equi-angular to the triangle ABC, for the line AB falls on the parallel lines DE AC, making the angle at A equal to the angle at D; the same may be understood of the line BC and the angles at C and B, the angle at B being common to both triangles.

Then AD : CE : : DB : EB, and AB : DB : : AC : DE, &c. &c.

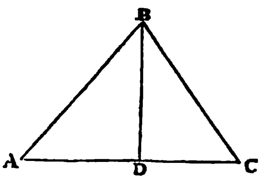
Theorem E [Eu. vi. 3.]

If a right line bisect any angle of a triangle, it divides the opposite side into two segments, which are proportional to the two other sides. In the triangle ABC, let the line BD bisect the angle at B, then the segment AD : the segment CD : : AB : BC, or AD : AB : : DC : BC.



Demonstration.—Let ABC be a triangle, and draw the line BD bisecting the angle ABC. Produce AB and through C draw CE parallel to BD, meeting AB produced in E. Now because CE is parallel to BD, the angle AEC =ABD [Eu. i. 29.] For the same reason the angle ECB is equal to the alternate angle CBD: but CBD=ABD, because the angle ABC is bisected; therefore the angle ECB=ABD=BEC; hence EB=BC. [Eu. i. 6.] Again, because BD is parallel to CE, it cuts the sides AE AC, proportionally in the points B and D; [Eu. vi. 2.] or [Theorem D, above,] therefore, as AB : BE : : AD : DC; but BE=BC; therefore as AB : BC : : AD : DC. Q.E.D.

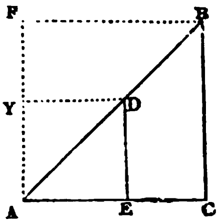
Theorem F.



In a right angled triangle, a perpendicular, from the right angle is a mean proportional between the segments of the base; and each of the sides including the right angle, is a mean proportional between the hypothenuse and the adjacent segment. In the triangle ABC, let BD be the perpendicular, then BD is a mean proportional between AD DC; for AD : BD : : DB : DC; and BC is a mean proportional between AC and DC, for AC : CB : : CB : DC; also AB, is a mean proportional between AC and AD, for as AC : AB : : AB : AD.

Corrollary.—AB squared is to BC squared as AD^2 is to DC^2. [Eu. vi. 22.]

Theorem G. [Eu. vi. 19.]



Equi-angular or similar triangles are to each other as the squares of their like sides. Let ABC ADE be two similar triangles, the triangle ABC : the triangle ADE : : the square of AC : the square of AE; for construct the rectangle AC and CB, = FB CA, and that of AE and ED = YDEA; admit both these rectangles to be squares, it is plain the one is to the other, as the square of one side is to the square of the other.

Corrollary 1st.—A circle may be considered as bounded by a continuous curve line, composed of an *infinite number of straight lines*, each infinitely small; it represents therefore a polygon of an infinite number of sides, making altogether the circumference of the circle. But similar polygons may be divided into an equal number of similar triangles, each pair being as the squares of their homologous or like sides; and, as any one antecedent is to its consequent, so is the sum of all the antecedents to the sum of all the consequents; [Eu. v. 12.]; therefore as the square of any side of a polygon is to the square of the corresponding side of a similar polygon, so is the sum of all the antecedents, (the triangles composing the first polygon,) to the sum of all the consequents, (the similar triangles composing the other.) And, hence, as the square of the circumference or diameter of any circle, is to the square of the circumference or diameter of another circle, so is the area of the first circle to the area of the other. Q.E.D.

This, in Euclid's Elements, is the 20th Prop. of the 6th Book, Corollaries 1st. and 2nd.

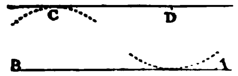
Corrollary 2nd.—And as a side of each polygon is equal to a part of the circumference, the radius of the circle being a perpendicular from the centre of the polygon, then that radius will be to that side of the polygon, as the radius of another circle will be to a similar side of a similar polygon; therefore the circumferences of circles will be in proportion to their radii.

PROBLEMS.

Problem I.

Through a given point to draw a straight line parallel to a give straight line.

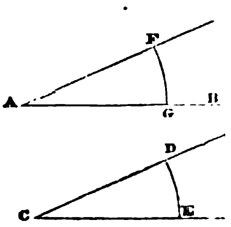
Let D be the given point, and AB the given straight line.



Take the nearest distance from D to AB in the compasses, and with one foot on any part of the line AB, describe the arc C, and through C and D draw the straigh line CD, and it will be parallel to AB.

Problem II.

At a given point in a given straight line to make a rectilinear angle equa to a given rectilinear angle.

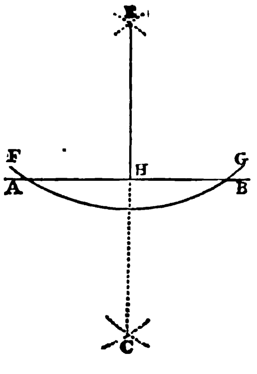


Let AB be the given line, and A the given point in it, and DCE the given angle.

From the point C, with any convenient radius describe the arc DE; with A as a centre and the same distance, describe the arc FG. Take the distance DE in the compasses and set it off from G to F on the arc GF; through F, from the point A, draw the line AF, then FAB will be the angle required.

Problem III.

From a given point E, *to let fall a perpendicular on a given right line.*

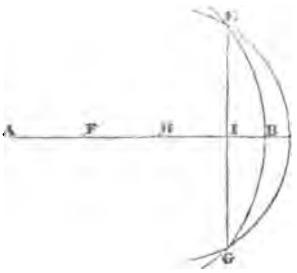


Let AB be the given straight line, and E, the given point.

With E as a centre, describe an arc cutting AB in the points F and G. From the points F and G as centres, with any distance greater than half FG, describe two arcs intersecting each other in the point C. Join FC, then EH will be the perpendicular required.

If the point E be towards the end of the line.

Take any point F, in AB as a centre, and with the distance FE, describe the arc EG. And from any other point H, in AB, and distance HE, describe another arc cutting the former in E and G. Join EG, then EI will be the perpendicular required.

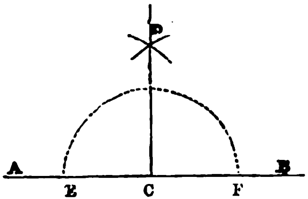


Problem IV.

To draw a straight line at right angles to a given straight line, from a given point in the same.

Let AB be the given straight line, and C the given point.

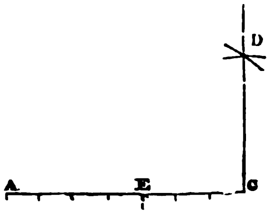
From the point C, and with any convenient distance less than CA or CB, describe the arc EF. From E and F as centres, and with any distance greater than CE or CF, describe arcs cutting each other in D. Through the point of intersection D, draw the straight line DC, and it will be perpendicular to AB.



When the given point is at or near the end of the line.

Take any small distance in the compasses, set it off five times from C towards A. With C as a centre, and a distance equal to four of these parts describe an arc. With E as a centre (the third point from C,) and a distance equal to five of the aforesaid parts, cross the arc in D.

Draw the right line DC, which will be the perpendicular required.

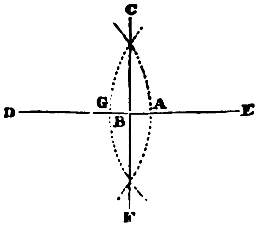


Problem V.

To bisect a given straight line.

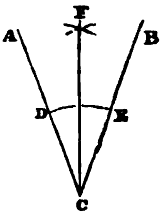
Let DE be the given straight line.

With D as a centre, and any distance greater than half the line, describe the arc CAF. With E as a centre, and the same distance, describe the arc CGF. Join CF, and the line CF will bisect the straight line DE in the point B.



Problem VI.

To bisect a given angle.

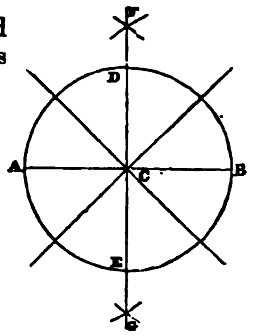


Let ABC be the given angle.

With C as a centre, and any convenient distance describe the arc DE. From D and E as centres, with the same or any other distance, describe arcs intersecting each other in F. Join CF, and the line CF will bisect the angle ACB.

Problem VII.

To divide a given circle into 2, 4, 8, 16, 32, *equal parts.*

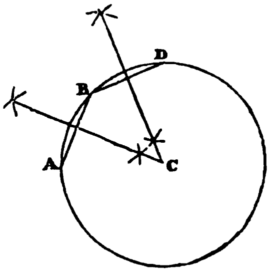


Let ADBE be the given circle.

Draw the diameter AB and the circle is divided into two equal parts. From A and B as centres with any distance exceeding half the line AB, describe the arcs F and G, and join the intersecting points F and G. The line DE is a diameter, cutting AB at right angles, and thereby dividing the circle into four equal parts or quadrants. Bisect the four angles at C by the foregoing problem, and the circle will be divided into eight equal parts, each of which may be again subdivided in a similar manner, and so on till the circle is divided into the required number of parts.

Problem VIII.

To find the centre of a given circle, or circular arc.



Let ABD be the given circle.

Take any three points in the circumference of the circle, as A, B, D; connect the middle point with each of the others by a line or chord. Bisect the chords , AB BD, by perpendicular lines; which lines will intersect each other at the centre C of the circle.

PLANE TRIGONOMETRY.

Plane Trigonometry is that branch of Mathematical Science by which we measure the sides and angles of plane triangles, that is, such as are composed of right lines. It is divided into right angled and oblique angled Trigonometry, according as it is applied to the resolution of right or oblique angled triangles: we will therefore commence with

RIGHT ANGLED PLANE TRIGONOMETRY,

Elementary Principles.

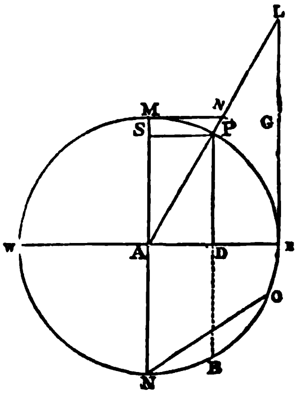
Let WMNE represent a circle divided into four quadrants of 90° each.

The *complement* of any arc is the difference between that arc and a quadrant. It is also what any ∠ wants of 90°. Thus, if the arc EP be divided into the two arcs EP PM, the arc MP is the complement of the arc EP: or the ∠ MAP, is the complement of the ∠ EAP.

The *supplement* of any arc is the difference between that arc and a semicircle; or it is the number of degrees, minutes, &c. which any ∠ wants of 180°. Thus, the arc PMW is the supplement of the arc EP, and the ∠ PAW, is the supplement of the ∠ EAP.

Two arcs whose sum is equal to a semicircle, or two angles whose sum is equal to two right angles, are called supplements to each other.

Two arcs whose sum is a quadrant, or two angles whose sum is a right angle, are called complements of each other.



The *sine* of an arc, is a straight line drawn from one extremity of an arc perpendicular to a diameter passing through the other extremity of the same arc. Thus, PD is the sine of the arc PE. It is also the sine of the supplemental arc PMW.

The sine of an arc of 90° is equal to the radius, thus, AM is the sine of the quadrantal arc EM.

The *tangent* of an arc is a right line drawn from one extremity of the arc perpendicular to the diameter passing through that extremity, and is terminated by a right line drawn from the centre of the circle through the other extremity of the arc. Thus, EL is the tangent of the arc EP.

The tangent of any arc is equal to the tangent of the supplement of that arc. The tangent of 45° is equal to the radius, and the arc of 90° has no tangent, for it is infinite.

The *secant* of an arc is a straight line drawn from the centre of the circle, and produced till it meets the tangent. Thus, AL is the secant of the arc EP.

The secant of any arc is equal to the secant of the supplement of that arc. The secant of 45° is equal to double the sine of 45°, and an arc of 90° has no secant.

The sine, tangent, and secant of any arc, are the sine, tangent, and secant of the angle that includes the arc, or is measured by it; thus, the sine, tangent and secant of the arc EP, are also the sine, tangent and secant of the ∠ EAP.

The *cosine* of an arc, is the sine of the complement of that arc; or it is that part of the diameter contained between the centre of the circle and the sine. Thus, SP is the cosine of the arc EP, being the sine of the arc PM, which is the complement of EP; and because AD=SP, AD is also the cosine of EP.

The cosine of an arc, is equal to the cosine of its supplement.

The *cotangent* of an arc, is the tangent of the complement of that arc. Thus, MN is the cotangent of the arc EP, being the tangent of the complemental arc PM.

The cotangent of an arc, is equal to the cotangent of its supplement.

The *cosecant* of an arc is the secant of the complement of that arc. Thus AN, is the cosecant of the arc EP, being the secant of its complemental arc PM.

The cosecant of an arc, and the cosecant of its supplement, are of the same magnitude.

The cosine, cotangent, and cosecant of any arc, are the cosine, cotangent, and cosecant of the ∠ which that arc measures. Thus, the cosine, cotangent, and cosecant of the arc EP, are respectively the cosine, cotangent, and cosecant of the ∠ EAP.

The *versed sine* of an arc, is that part of the diameter of the circle, which is contained between the sine and the arc. Thus DE is the versed sine of the arc EP, and DW is the versed sine of the supplemental arc PMW.

The versed sine of the supplement of an arc, is the difference between the versed sine of that arc and the diameter.

Projection of the Plane Scale.

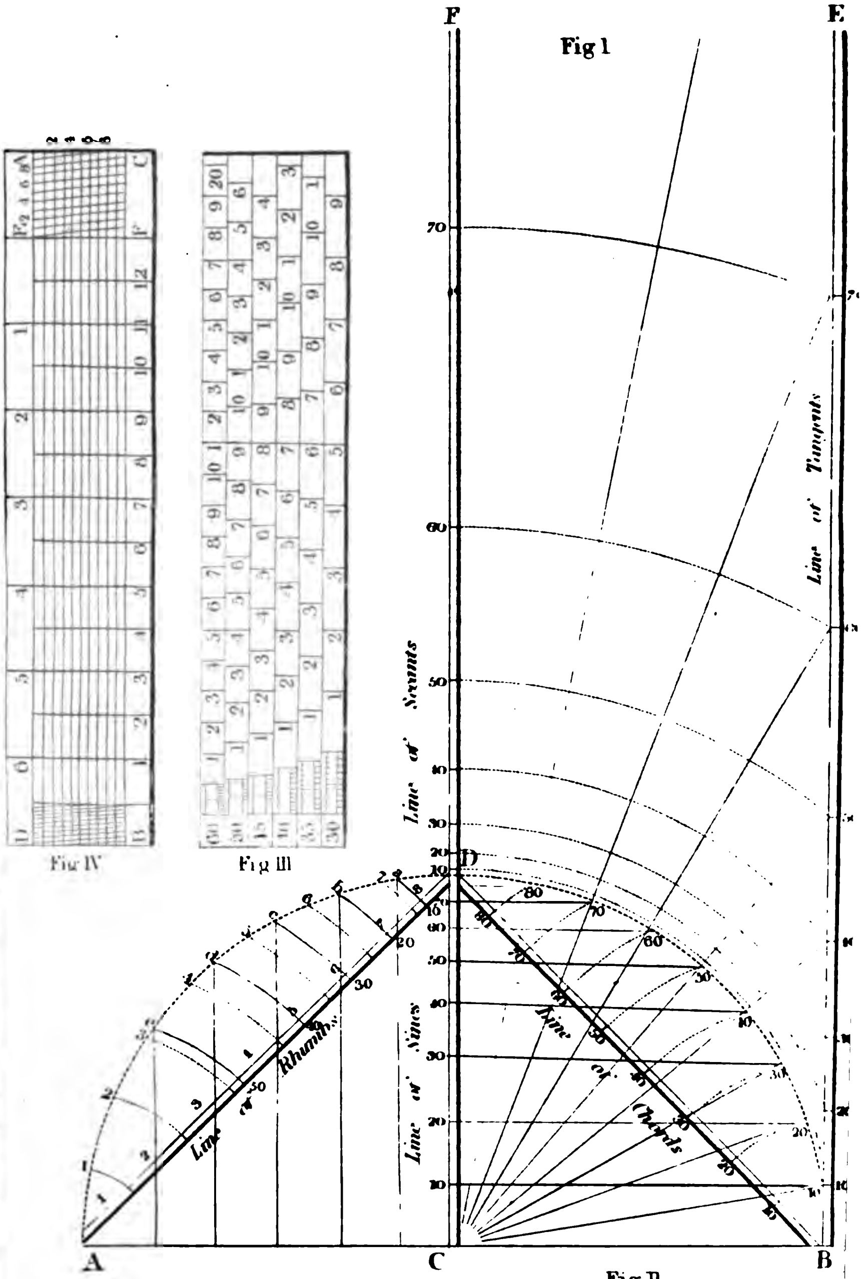
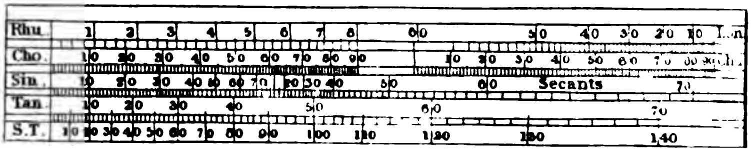


Fig IV

Fig III

Fig I

Fig II



The versed sine of an arc is equal to the radius diminished by the cosine, for DE = AE — AD.

The *su-versed sine* of an arc, is the versed sine of the complement of that arc. Thus, MS is the su-versed sine of the arc EP, being the versed sine of the complemental arc PM.

The *chord* of an arc is a straight line drawn from one extremity of the arc to the other. Thus, NO is the chord of the arc NBO, or of the arc NWMPEO.

The chord of an arc of 60°, is equal to the radius of the circle.

From these definitions, it is obvious that every degree in the quadrantal arc EM (with the exceptions already pointed out) may have its respective sine, tangent, &c. We shall therefore proceed to shew how these may be drawn, to any given or assumed radius, which operation constitutes,

THE CONSTRUCTION OF THE PLANE SCALE.

This scale is an instrument of extensive application in various branches of practical mathematics. The Mariner's scale, or that generally used at sea, is a flat ruler two feet in length, having drawn upon it, besides the diagonal and other scales of equal parts, a variety of lines derived from, and adapted to a circle of an assumed radius, whereby the sides and angles of triangles and other mathematical figures, may be constructed and measured, and many important mathematical problems may be solved, with expedition and considerable accuracy.

With any convenient radius, CB (Fig. 1, Plate II.) describe a semicircle, on the centre C, erect the perpendicular CD, and produce it to F, draw BE parallel to CF, and join AD and BD.

RHUMBS.*—Divide the quadrantal arc AD into eight equal parts, with one foot of the compasses in A, transfer the distances A 1, A 2, A 3, &c. to the straight line A D, and it will be a line of rhumbs; containing eight points of the compass or one fourth of its whole circumference. By subdividing each of the divisions A 1; A 2; &c. into four equal parts, and transferring them in the same manner to the line AD, it will contain, in addition to the points, the half and quarter points.

---

* Rhumbs, and a few other terms not included in the foregoing definitions, will be sufficiently understood from the description here given.

Chords.—Divide the arc BD into nine equal parts, with one foot of the compasses in B, transfer each of these divisions to the line BD, which will then become a line of chords constructed to every ten degrees.

Sines.—The same divisions being transferred by lines parallel to the radius BC, to the line CD; that line will become a line of sines.

Tangents.—From the centre C, but commencing at the several divisions of the quadrantal arc BD, draw lines to the straight line BE; which will thence become a line of tangents.

Secants. With the foot of the compasses in C, as a centre, transfer the distances between the centre C, and the divisions of the line of tangents to the line DF, and it will become a line of secants, which must be numbered from D towards F, as in the Fig.

Semi-Tangents.—If from A, right lines be drawn to the several divisions of the arc BD, they will divide the line CD into semi-tangents, which must be numbered with the corresponding figures of the arc, 10, 20, &c. These divisions being little used are left out of the Fig. to avoid confusion.

The preceding lines, which are all adapted to one radius, are the most important in practice, and are commonly transferred from such a general Fig. as we have been describing, to a plane scale or ruler, and arranged in the manner shewn in Fig. 2. Besides these there are, on the Mariner's Scale, several other lines derived from the circle, such as

Miles of Longitude.—Divide the line AC into six equal parts, through each of these draw lines, *a*10, *b*20, *c*30, &c. parallel to CD, and these will cut the line AD, in the points *a*, *b*, *c*, &c. From A as a centre, transfer these several divisions of the arc AD, to the line AD, which will thence become a line of longitude. This line is laid upon the scale close to the line of chords, but in an inverted position, so that 60 on the line of longitude, is against 0 in the chords, &c. as in the Fig.; then if any degree of latitude be counted on the line of chords, there will stand opposite to it, on the line of longitude, the miles contained in one degree of longitude in that parallel of latitude, a degree at the equator being 60 miles. This line is generally drawn to a larger radius than those above described, and is consequently applied to a larger scale of chords.

Equal Parts.—The divisions of the line AC, to form the line of longitude, may be considered as a line of equal parts, and is in general laid down as such, marked Lea. Other scales of equal parts, as represented in Fig. 3, are also introduced on some scales; these are so obvious as to require no particular description, but the most perfect scale of equal parts is that called

The Diagonal Scale.—To constitute which, draw eleven lines parallel to, and equidistant from each other, as in Fig.4. Divide the upper line, as AB, into such a number of equal parts as may suit the intended dimensions of the scale, (the most usual number is ten, of an inch each); from these several divisions, draw perpendicular lines to the lower line CD: subdivide the first of these larger divisions AE, CF, into ten equal parts, and from the first division in the line AE, draw a diagonal right line to the point C, and lines parallel to this through all the succeeding subdivisions; then each diagonal line in passing from the line AC, to CF, will be one tenth of the subdivisions farther from the line EF, at the points where they intersect each succeeding parallel from AE, to CF, that is, one hundredth part of the larger division, which is consequently thus divided into one hundred equal parts.

In reading off this scale therefore, if the larger divisions be accounted hundreds, then the first subdivisions will be tens, and the second subdivisions units; but if we take the larger divisions as tens, then the first subdivisions will be units and the second tenths, and so on; the value of the subdivisions always depending upon that assigned to the larger divisions.

The numbers increasing from left to right along the *bottom* of the scale, indicate the larger divisions of a scale, the subdivisions of which are found towards the *left*-hand. The dimensions of this scale are just one-half of that already described; to which it is, however, in all other respects precisely similar, but is read off in a contrary direction.

The method of taking off any number from the diagonal scale by a pair of compasses, will be understood from the following example.

Let it be required to take off the number 348.

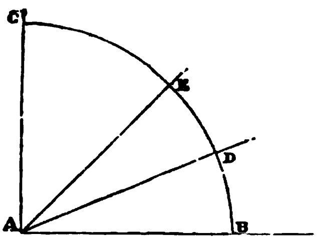
Find the first figure (3) among the perpendicular lines, marking the larger divisions along the top of the scale, and the second figure (4) among the first subdivisions or those marked at the top of the diagonal lines towards the right hand end of the scale. Follow this diagonal line down to its intersection with the parallel line marked 8, at the extremity of the scale, and fix one foot of the compasses in this point of intersection; then extend the other foot to that point of the same parallel which is intersected by the perpendicular line marked 3, and that distance will be the extent required. The same distance may, besides the given number 348, also indicate 34·8 or 3·48, according to the value assigned to the larger division, as has been already explained.

If the number to be taken off the scale consist of four or five places of figures, it may be divided by any number which will reduce it to two or three places; observing that when this is done in constructing any figure, the required sides when measured by the same scale, must be multiplied by that number by which the given side was divided, to obtain their true length or value.

As sides or lines are drawn or measured by the diagonal scale, so angles are measured or laid off, by means of the line of chords already described, in the following manner.

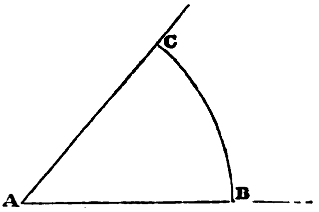
To lay off from the given line AB *at the point* A, *one or more angles of any proposed number of degrees, as* 20° 45° *and* 90°.

From the scale of chords take the chord of 60° in the compasses, and with the centre A describe the arc BC; and from the same scale with the chord of 20° in the compasses, set off that distance from B to D on the arc BC. On the same arc from the point B set off in like manner the chord of 45° to E, and again from E to C. Through D E and C, draw straight lines from the point A, then BAD, BAE, and BAC, will be the required angles of 20°, 45°, and 90°, respectively.



To measure any given angle, as A, *by the scale of chords.*

With the chord of 60° in the compasses, and one foot on the angular point A, describe the arc BC, cutting the legs in B and C, then the distance BC applied to the scale of chords with one foot of the compasses at the beginning of that scale, will shew the measure of the angle A, which in this instance is 50°.



When the angle to be measured or laid off exceeds 90°, measure or lay off 90°, and then from that point the excess above 90°.

A FEW GENERAL PRINCIPLES

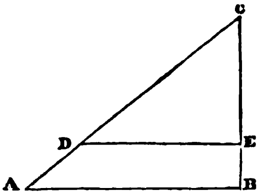
Upon which the solution of the different cases of Right-angled Plane Trigonometry depends.

Every plane triangle consists of six parts, viz, three sides and three angles; any three of which being given, except the three angles, the other three may be found by logarithmical calculation.

The three angles of every plane triangle, are together equal to 180° or two right angles. Hence in a right-angled plane triangle, the sum of the two acute angles is equal to 90°; therefore if one of the acute angles be given, the other may be found by subtracting the given angle from 90°.

If one of the acute angles of a right-angled triangle be 45°, or half a right angle, the other acute angle will also be 45°, and the base and perpendicular will be equal to each other.

When two lines are parallel, any straight line, cutting them, makes the same angle with one of them as with the other; hence.



If two right-angled triangles ABC, DEC have one of the acute angles as C, common to both the triangles, they are equiangular; for the lines AB DE are parallel, and they are cut by the line CA, therefore the angle CDE is equal to the angle CAB, [Eu. i. 29.] they are cut by the line CB also; therefore the angle CED is equal to the angle CBA, and the angle C being common, the two triangles are equiangular.

But two triangles are said to be similar when all the angles of the one triangle are respectively equal to all the angles of the other: the triangles CDE and CAB are therefore similar.

In two similar triangles the sides about the equal angles are proportional, viz: [Eu. vi. 4.]

CA : AD : : CD : DE
AC : CB : : DC : CE
CB : BA : : CE : ED

Hence if a straight line be drawn parallel to one of the sides of a plane triangle, it will cut the other two sides proportionally, [Eu. vi. 2.] or Theorem D, page 26.

Any two sides of a triangle are together greater than the third side [Eu. i. 20.] or Theorem IX. page 19. From this it follows also, that the difference of any two sides of a triangle is less than the third side.

In every triangle the greatest side is opposite the greatest angle, and *vice versa*, [Eu. i. 18 19.] or Theorem VII. page 18. Also equal sides subtend equal angles, and conversely [Eu. i. 5 and 6.]

PRACTICAL RULES

For the solution of all the different cases of right-angled plane triangles with their application by logarithms.

In every right-angled plane triangle, there must be two given quantities, one of which must be a side, (together with the right angle,) to find the rest.

In every right-angled triangle one of the sides must be considered the radius of a circle.

If the *hypothenuse* be assumed equal to the radius, the sides, that is the base and perpendicular, will become the sines of their opposite angles; and if either of the sides be considered the radius, the other side will become the tangent of its opposite angle, and the hypothenuse, the secant of the same angle.

Thus, if in the triangle ABC, Fig. 1. the hypothenuse AC be made radius, then by the foregoing definitions, it is evident that AB will be the sine of the angle C, and BC will be the sine of the angle A. But the sine of either of the acute angles of a right angled triangle, is the cosine of the other acute angle: hence AB, the sine of the angle C, is the cosine of the angle A; and BC, the sine of the angle A, is the cosine of the angle C.

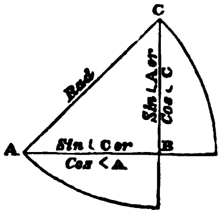


Fig. 1.

If, in the triangle ABC. Fig. 2. the base AB be made radius, then the perpendicular BC becomes the tangent of the angle A, and the hypothenuse AC, the secant of the same angle: they are therefore respectively the cotangent and cosecant of the angle C.

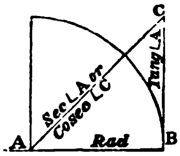


Fig. 2.

If, as in Fig. 3. the perpendicular BC, be made radius, then the base AB, will be the tangent, and the hypothenuse AC will be the secant of the angle C; they will therefore be respectively the cotangent and cosecant of the angle A.

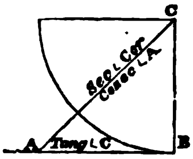


Fig. 3.

To find a side.

Consider any one of the sides of the triangle, whether given or not given, as the radius of a circle, and write upon it the word *radius*; observe whether the other sides become sines, tangents, or secants, and write these words upon them accordingly, and call each name so written the *name* of that side to which it is applied; then say,

As the name of the given side
Is to the given side,
So is the name of the required side,
To the required side.

To find an angle.

Call one of the given sides radius, and write upon it the word *radius*; observe whether the other sides become sines, tangents, or secants, and write upon them accordingly: then say,

As the side made radius,
Is to radius,
So is the other *given* side,
To its name.

The proportions thus stated are to be worked by logarithms, as follows:—

To the arithmetical complement of the first term, add the logarithms of the second and third terms, rejecting 20 or 10 from the index, according as the required term may be a side or an angle; then the sum will be the logarithm of the fourth term, which being found in its proper table, will give the side or angle required.

Note.—The logarithms for sides are to be taken from Table 4, and the logarithms for sines, tangents, and secants of angles, from Table 5, according to the directions given in the *Explanation* to those Tables, which explanation should be carefully perused before attempting to use the tables themselves.

Observe also, that the logarithm of the radius is always 10.

SOLUTIONS

Of the six cases in Right-angled Plane Trigonometry.

Each of these is resolved by two different methods, viz. by logarithmic calculation, and by geometrical construction.

CASE 1.

Given the angles and the hypothenuse, to find the base and the perpendicular.

Given $\left\{ \begin{array}{l} \text{the hyp. AC} = 645 \\ \text{the } \angle \text{ A} = 39^\circ\ 10' \end{array} \right\}$ Required the base AB, and the perpendicular BC.

By Calculation.

* Making the hypothenuse rad. BC will be the sine of the angle A, and AB, the cosine of the same angle.

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* In the first example, all the different sides are in succession made radius; but in all the other examples, one side only is made radius, and this side is always the hypothenuse, except in Case 6, in which the angles are required, and the hypothenuse is *not* one of the given sides.

To find the base AB.

As rad.	10·00000
: hyp. AC=645	2·80956
:: cos. ∠A=39° 10′	9·88948
: base AB=500·1	2·69904

To find the perp. BC.

As rad.	10·00000
: hyp. AC=645	2·80956
:: sin. ∠ A 39° 10′	9·80043
: perp. BC=407·4	2·60999

Making the *base* rad. BC will be the tang. of the ∠ A, and AC the sec. of the same ∠.

To find the base AB.

As sec. ∠ A 39° 10′ (co. ar.)	9·88948
: hyp. AC=645	2·80956
:: rad.	10·00000
: base AB=500·1	2·69904

To find the perp. BC.

As sec. ∠ A=39° 10′ (co. ar.)	9·88948
: hyp. AC=645	2·80956
:: tang. ∠ A 39° 10′	9·91095
: perp. BC =407·4	2·60999

Making the perp. rad. AB will be the tang. of the ∠ C, or cotang. of the ∠ A, and AC the sec. of the ∠ C, or cosec. of the ∠ A.

To find the base AB.

As cosec. ∠ A 39° 10′ (co. ar.)	9·80043
: hyp. AC, = 645	2·80956
:: cotan. ∠ A 39° 10′	10·08905
: base AB=500·1	2·69904

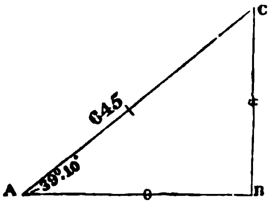
To find the perp. BC.

	9·80043
	2·80956
:: rad.	10·00000
: perp.=407·4	2·60999

By Construction.

In this method of operation, the given parts of the triangle are generally marked with a *dash*, and the required side with an *o*, as in the figure annexed to the constructions; also the angles are measured and laid off by a scale of chords, and the sides from a scale of equal parts.

Draw the indefinite line AB, and make the ∠ A=39° 10′ draw the line AC (the hyp.) =645 and from C let fall the perp. BC; then ABC is the △ required, of which AB=500·1, and BC=407·4 measured on the same scale by which the hyp. was drawn.



CASE II.

Given the angles and the base, to find the hypothenuse and the perpendicular

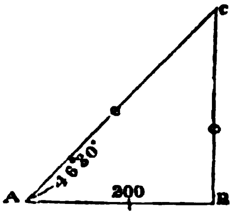
Given { the ∠ A=46° 30′ / the base AB =200 } Required the hyp. AC, and the perp. BC.

By Calculation.

To find the hyp. AC.		To find the perp. BC.	
As cos. ∠A 46° 30′(co.ar.	0·16219	....	0·16219
: base AB =200	2·30103	....	2 30103
:: rad.	10·00000	:: sin. ∠A 46° 30′.....	9·86056
: hyp. AC=290·5.....	2·46322	: perp. BC=210·8	2·32378

By Construction.

Draw the base AB=200; at B erect the perpendicular BC, and make the angle A=46° 30′: draw the hypothenuse AC to cut the perpendicular BC in C; then will AC measure 290·5, and BC 210·8



Case III.

Given the angles and the perpendicular, to find the base and the hypothenuse.

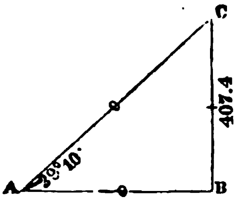
Given $\left\{\begin{array}{l}\text{the } \angle \text{ A}=39^\circ.\ 10'\\ \text{the perp. BC}=407\cdot4\end{array}\right\}$ required the hyp. AC, and the base AB.

By Calculation.

To find the hyp. AC.		To find the base AB.	
As sin. ∠A 39° 10′(co.ar.)	0·19957	....	0·19957
: perp. BC=407·4....	2·61002	....	2·61002
:: rad.................	10·00000	:: cos. ∠A=39° 10′....	9.88948
: hyp. AC=645·0.....	2·80959	: base AB=500·1	2·69907

By Construction.

Draw the indefinite right line AB, and on B erect the perpendicular BC, which make equal to 407·4; at C, make the angle C=50° 50′=complement ∠ A. From C draw the hypothenuse AC, cutting the line AB, in A, then will AC measure 645 and AB, 500·1.



Case IV.

Given the hypothenuse and base, to find the angles and the perpendicular.

Given $\left\{\begin{array}{ll}\text{the hypothenuse AC} = 430 \\ \text{the base AB, } 214\end{array}\right\}$ required the angles A and C, and the perp. BC.

By Calculation.

To find the angles.

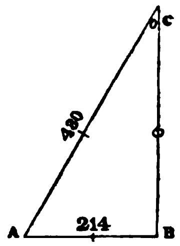
As hyp. AC = 430 (co. ar.)	7·36653
: rad.	10·00000
:: base AB = 214.	2·33041
: cos. ∠A = 60° 9′ ∠C = 29·51	9·69694

To find the perp. BC.

As rad.	10·00000
: hyp. AC = 430.	2·63347
:: sin. ∠A = 60° 9′.	9·93819
: perp. BC = 373·0	2·57166

By Construction.

Draw the line AB = 214, on B erect the perpendicular BC; with the distance AC = 430 and centre A, cut the line BC in the point C, and draw the hypothenuse AC; then will BC = 373, and the angles A and C will be respectively 60°9′ and 29°51′.



Case V.

Given the hypothenuse and perpendicular, to find the angles and base.

Given $\left\{\begin{array}{ll}\text{the hyp. AC} = 540 \\ \text{the perp. BC} = 455\end{array}\right\}$ required the angles A and C, and the base AB.

By Calculation.

To find the angles.

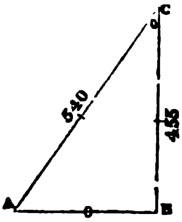
As hyp. AC = 540 (co. ar.)	7·26761
: rad.	10·00000
:: perp. BC = 455	2·65801
: sin. ∠A = 57° 25′ ∠C = 32·35	9·92562

To find the base AB.

As rad.	10·00000
: hyp. AC = 540	2·73239
:: cos. ∠A = 57° 25′. . . .	9·73121
: base AB = 290·8	2·46360

By Construction.

Draw the base AB, of an indefinite length; at B. erect the perpendicular BC = 455, take AC = 540, in the compasses, and from the centre C, cut the base AB in A, and join AC; then will AB = 290·8, and the angles A and B be respectively = 57° 25′ and 32° 35′.



CASE VI.

Given the base and perpendicular, to find the angles and the hypothenuse.

Given { the base AB = 225·5, the perp. BC = 276 } required the angles A and C, and the hyp. AC.

By Calculation.

To find the angles,

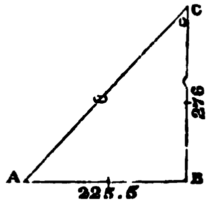
As base AB = 225·5 (co. ar.)	7·64685
: rad....................	10·00000
:: perp. BC = 276........	2·44091
: tang. ∠A = 50° 45′ ∠C – 39° 15′ ...	10·08776

To find the hyp. AC,

As rad....................	10·00000
: base AB = 225·5......	2·35315
:: sec. ∠A = 50° 45′......	10·19880
:: hyp. AC = 356·4.......	2·55195

By Construction.

Draw the base AB = 225·5, and on B erect the perp. BC = 276; draw the line AC, which will become the hypothenuse, and will be = 356·4; also, the angle A, will be 50° 45′, and the angle C = 39° 15′.



Examples for Exercise.

1. Given the hypothenuse AC, 355, and the angle A, opposite the perpendicular, 33° 30′: required the base AB, and the perpendicular BC.?

Answer.—The base AB = 296,
and the perpendicular BC = 195·9

2. Given the base AB, 62·5, and the angle A 53° 51′: required the hypothenuse AC, and the perpendicular BC.?

Answer.—The hypothenuse AC = 105·95,
and the perp. BC = 85·55.

3. Given the perpendicular BC, 296, and the angle A, 44° 10′: required the hypothenuse AC, and the base AB?

Answer.—The hypothenuse AC = 424·8,
and the base AB = 304·7

4. Given the hypothenuse AC, 480, and the base AB, 288; required the angles A and C, and the perpendicular BC?

Answer.—The angle A = 53° 8′
the angle C = 36° 52
and the perp. BC = 384·1

5.—Given the hypothenuse AC, 170, and the perpendicular BC, 91: required the angles A and C, and the base AB?

Answer.—The angle A = 32° 22′,
the angle C = 57° 38′
and the base AB = 143·6.

6.—Given the base AB, 72, and the perpendicular BC, 85: required the angles A and B, and the hypothenuse AC?

Answer.—The ∠A = 49° 44′,
the ∠C = 40° 16′,
and the hyp. AC = 111·4.

THE APPLICATION OF THE PRINCIPLES

OF PLANE TRIGONOMETRY

To the determination of Heights and Distances of remote objects.

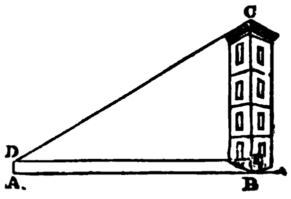
It is of great importance to the Navigator that he should be able, whenever occasion offers, to determine the Heights and Distances of objects that may present themselves on his approach to land; having therefore explained the principles of Plane Trigonometry in the preceding pages, its application to the measurement of accessible and inaccessible objects, will further illustrate the subject.

A base line is always supposed to be measured or given in length, and the angle which the altitude of an object subtends at one extremity of this line, and sometimes at each extremity, is measured by any instrument used on board, for the purpose of measuring angular distances.

In taking the height of an object, if the eye be not in the level upon which the object stands, then to or from the height found, must be added or subtracted the distance of the eye from the level, according as it is placed above or below it, and the sum or difference will be the true height of the object.

To find the Height of an accessible object.

Let CB denote the height of the object, AD the height of the eye, the angle CDE the given angle. DE being parallel to AB. In the triangle DEC, the side DE = AB and the angle D are given to find the perpendicular CE.



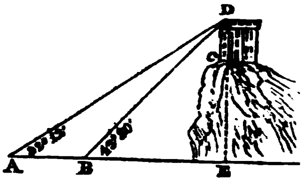
Example 1.

Wishing to know the height of a tower, I measured 116 feet from the base of it; and found the angle of elevation above the level of the instrument to be 37° 24′, the height of the eye 5ft: required the height of the tower?

		or,	
As cos. ∠ D = 37° 24′ (ar.co.)	0.09995	As radius............	10·00000
: DE the base 116 feet....	2·06446	: base 116 ft.	2·06446
:: sine ∠ 37° 24′...... ..	9·78346	:: tang. ∠ 37° 24′ ..	9·88341
: CE..............88·69 =	1·94787	: CE........ 88·69 =	1·94787
height of eye ...... 5·		height of eye 5·	
height of tower.... 93·69		93·69 height of tower	

To determine the Height and Distance of an inaccessible object

Let DC represent a light-house on the top of a hill, and B, a point in the horizontal plane; from this point observe the angle of altitude DBE, at any other point in the same plane as at A, observe the angle of altitude DAE, and measure the distance between the two stations A and B.



Example 2.

Given the ∠ at B = 43° 30′ and the ∠ at A = 32° 12′. The ∠ D will be = 11° 18′ the diff. between the angles B and A; with these and the distance between the two stations A and B = 112 feet, proceed as follows:

To find DB.		To find DE.	
As sine ∠ ADB = 11° 18′ ar.co.	0·70786	As radius..................	10·00000
: AB the base 112 feet.....	2·04922	: sine ∠ B = 43° 30′......	9·83781
:: sine ∠ A = 32° 12′......	9·72663	:: BD = 304·6...........	2.48371
: BD = 304·6, distance of first station from the top of the lighthouse.....	2·48371	: DE = 209·7, height of light-house above the horizontal plane......	2·32152

To find the horizontal distance of the object from the first station, it will be

As radius................	10·00000	
: sine ∠ D = 46° 30′......	9·86056	
:: BD = 304·6....	2·48371	
: BE = 220·9...........	2·34427	the hor. dist of the object from the first station B.

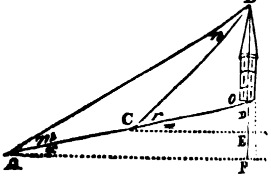
The following is a more concise method. To find DB, DE, *and* BE.

∠ ADB	= 11° 18′ co.sec.	0·70786		
base AB	= 112 feet log.	2·04922		
∠ A	= 32° 12′ sine ...	9·72663		
BD	= 304·6 feet.....	2·48371	....	2·48371
B	= 43° 30′ sine...	9·83781	cos.	9·86056
D E	= 209·7 feet.....	2·32152	(220·9 = BE	2·34427

DB the dist. of the top of the lighthouse from the station B = 304·6 feet
DE the height above the plane = 209·7 ,
BE the hor. dist. from B = 220·9 ,,

If the object stand on a rising ground, then find its heigth above the plane on which it stands by the last problem, as also the height of some point on the rising ground, at the foot of the object, and this last height subtracted from the former, will give the true height of the object; or proceed as follows.

Let BD be the object, and AD the inclined plane. Measure a base AC on the plane, and the angles of elevation A and C, of the top of the object, taken at the extremities of the base, and also the ∠ of elevation x of the plane, with the horizon.



To find the angles m, n, r, and o.

$r=\text{BCE}-x$, $m=\text{BAF}-x$, $n=r-m$, and $o=\text{E}$ or $90°+x$.

Example 3.

Required the height of a light-house BD, which stands on an inclined plane AD, the distance between the first station, C, and the second station A, being 120 feet, the angle of elevation at A being 50° 30′ and at C 72° 10′ the inclination of the plane with the horizon being 10°.

To find the respective angles.

$m=50° 30'-10°=40° 30'$

$r=72° 10'-10°=62° 10'$

$n=$ diff. m and $r=21° 40'=$ also diff. obs. ∠s at A and C.

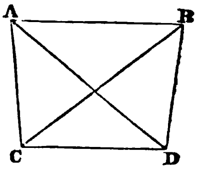
$o=90°+10°=100°$

Then to find BD, *proceed thus,*

∠n = 21° 40′ co. sec. ...	0·43273	
base AC = 120 ft. log.......	2·07918	
∠r = 62° 10′ sine......	9·94660	
AB = 287·4 feet.........	2·45851	.... 2·45851
∠m = 40° 30′ sine......	9·81254	
∠ o = 100° cosec....	0·00665	
∠ obs. at A = 50° 30′		sine 9·88741
B D = 189·5 feet	2·27770	(221·8 ft. = BF 2·34592

The top of the lighthouse is elevated 221·8 feet above the horizontal plane
The height of the lighthouse itself is 189·5 feet; and
The elevation of the rising ground is therefore 32·3 feet.

To determine the distance between two distant and inaccessible objects.



Measure the distance between two convenient stations as C, D, as a base, from each of which you can see the two objects; at the point C, observe the angles ACD and DCB, and at D observe the angles CDB, and CDA; then in the triangle CDB are given the two angles BCD and CDB, (consequently the angle CBD,) and the side CD, whence to find CB, it will be, as sine ∠ CBD : sine ∠ CDB : : CD : CB.

Again in the triangle ACD are given the two angles ACD and ADC (consequently the angle CAD) and the side CD, whence to find the side AC, it will be

as sine ∠ CAD : sine ∠ CDA : : CD : CA.

In the triangle ACB, are given the two sides AC and CB and the included ∠ ACB to find AB the distance between the two objects.

Example 4.

Suppose ∠ ACD is 94° 55′ the ∠ BCD 41° 25′ the ∠ CDB 103° 14 the ∠ ADC 46° 44′ and the side CD 144 feet.

To find CB

As sin. ∠CBD	=35° 21′ ar.co.	0·23764
: sin. ∠CDB	=103° 14′ ..	9·98831
:: CD	=144.......	2·15836
: CB	=242 3.....	2·38431

To find CA

As sin. ∠CAD	=38°21′ ar.co.	0·20728
: sin. ∠CDA	=46° 44′	9 86223
:: CD	=144........	2·15836
: CA	=169·0......	2·22787

Then to find AB, it will be

As AC + CB	=411·3 ar.co...	7·38584
: their diff.	= 73·3......	1·86510
:: tang of ½ sum ot CAB and CBA	=63° 15′	10·29753
: tang. ½ their diff.	=19° 28′	9·54847
∠ CAB	= 82 43	
∠ CBA	= 43 47	

again,

As sin. ∠CBA	=43° 47′ ar.co.	0·15994
: sin. ∠ACB	=53° 30′.....	9·90518
:: AC	=169·0......	2·22787
: AB	=196·3......	2·29299

the dist. between the two objects,

In like manner BD and DA may be found, from which and the included ∠ BDA, the distance may be found; the agreement of both results would be a sufficient proof of the correctness of the work.

Examples for Exercise.

1.—Required the height of a tower whose angle of elevation, observed at the distance of 33 yards from the bottom, was 53° 26′.

Answer.—44:49 yards.

2.—Required the height of an object the angular elevation of which was measured at the distance of 86 yards, and found to be 56° 20′.

Answer.—57·28 yards.

3.—At the top of a ship's mast 120 feet high, the angle of depression of another ship's hull was 15° 45′; what was the distance between the ships?

Answer, 425·5 feet.

4.—Required the height of a hill from the following measurements:—a base in the direction of the hill being measured 1356 feet, at the extremities of which the angles of elevation to the summit of the hill were found to be 25° 36′, and 36° 50′?

Answer, 1803·06 feet.

5.—In order to determine the height of a tower standing on the top of a hill, a base 240 feet was measured in the direction of the tower, and in the same vertical plane with it; at the nearer extremity of this base, the angles of elevation of the top of the hill and the top of the tower, were 40° and 51°; and at the further extremity, the angle of elevation of the top of the tower was 33° 45′. Required the height of the tower?

Answer, 112 feet, nearly.

NAVIGATION.

ELEMENTARY PRINCIPLES AND DEFINITIONS.

NAVIGATION is the art of finding the latitude and longitude of a ship at sea, and of determining her course and distance from that place to any other given place; it may therefore be defined, the art of conducting a ship through the vast and trackless ocean from one part of the world to another.

The place of a ship at sea is determined either by what is technically called *account*, or *dead reckoning*, or by *astronomical observation*, the former constitutes what is properly termed Navigation, and the latter Nautical Astronomy.

Now in order to become a skilful navigator, the mariner should have correct notions of the true figure and magnitude of the earth, with the relative situations of the principal lines and circles supposed to be delineated upon its surface; and he must also understand the nature and construction of charts, and the use and application of the instruments employed in determining the direction of the ship's track, and the velocity of its motion through the water.

Without dwelling upon the erroneous opinions entertained by the ancients respecting it, we shall at once assume, that the earth—by which we are of course understood to mean the earth and sea taken as one whole,—is of a figure very nearly, though not strictly, spherical, and shall adduce such familiar proofs of it, as may fall within the comprehension of every ordinary understanding.

If standing on the sea shore on a fine clear day, we view a ship leaving the coast in *any* direction, the hull or body of the vessel first disappears, afterwards the rigging becomes invisible, and lastly the top of the mast vanishes from our sight. Now this phenomenon is evidently caused by the convexity of the water between the eye and the ship, for were the surface of the sea an extended plain, the largest and the most conspicuous part of the vessel would be visible the longest.

If we sail out of sight of land, we behold the surface of the sea, not losing itself in distance, but terminated on all sides by one continuous sharp, clear, well defined line, called the marine horizon; and as all parts of this line appear equally distant from the eye, we naturally infer that it is a true circle, of which we occupy the centre. In like manner a spectator on land, if all the inequalities of surface and other intervening objects were removed, would find his view bounded by a similar circle, in which the earth and sky would appear to meet.

The higher the eye is raised, the farther is the view extended, for it is very common for sailors, from the top of the mast, to discover ships, or land, at a greater distance than they can do when standing upon deck; yet the *sea offing*, or marine horizon, still retains its circular form, and if we ascend in a balloon, or on mountains, to any very considerable height above the surface of the earth, the visible area becomes still more enlarged, while its *angular diameter*, or the angle it subtends at the eye, is sensibly diminished; yet the boundary line of the area—the marine or terrene horizon—when not obscured by atmospheric circumstances,or interrupted by local objects, is still a circle. Now the results are always the same in whatever part of the earth similar experiments are made, and a body, which under every point of view appears always circular, can be no other than a sphere or globe.

The Earth has been sailed round by many navigators, who steering constantly in one direction, that is, making only such deviations from a *direct* course, as the stretching out of lands, adverse winds, &c. might require, but without, what may be called, *turning back again*, have returned to the port they sailed from, in a direction exactly the reverse of that in which they left it, after having experienced all those phenomena, which should naturally arise from the globular form of the earth.

Nor do the irregularities of the earth's surface present any serious objection to the general sphericity of its figure; since the perpendicular elevation of the highest mountain known, does not exceed five miles, and consequently bears no greater proportion to the bulk of the earth, whose diameter is nearly 8,000 miles, than a grain of sand does to a twelve inch globe; and as there are no continents, or even any very extensive tracts of land, whose general elevation above the seas which intersect, or the oceans that surround them, is any thing like so considerable, it is evident they could cause no visible irregularities on the surface of a globe of the above dimensions.

Owing however to the diurnal rotation of the earth on its axis, its figure is not that of a true sphere, but of an oblate spheriod, being flattened at the polar, and swelled out at the equatorial regions; for those parts being most remote from the axis of rotation, their gravity must be most diminished by the centrifugal force arising from their rapid motion; and this diminution gradually decreases as we approach the poles, where it is nothing; hence the earth even though it were originally a perfect sphere, would naturally assume its present spheroidal form. The figure of the earth, however, differs so little from that of a true sphere, its equatorial diameter (7,924 english miles) only exceeding its polar by about 25 miles, that for all nautical, and for most astronomical purposes, it may for the ease of calculation be considered as a perfect globe.

The diameter about which the earth revolves is called its *axis*, and the extremities of that diameter are denominated the *poles* of the earth, one of which is named the *north*, and the other the *south pole*.

The equator, generally by seamen called the *line*, is a great circle, equidistant from both poles, and dividing the earth into two equal parts, called the *northern* and *southern hemispheres*. The equator, like all other great circles, is divided into 360 equal parts, called degrees, and these are again sub-divided each into 60 equal parts called *miles* or *minutes*, and each minute into 60 equal parts, called seconds.

Meridians are great circles, cutting the equator at right angles, and passing through the poles. Every point upon the surface of the earth may be supposed to have a meridian passing through it; and places lying due north and south of each other, are said to have, or to be on the same meridian. That meridian passing through the Royal Observatory at *Greenwich*, is, by English geographers, termed the *first meridian*, and all the tables in the Nautical Almanac, and other *English* astronomical tables are adapted to that meridian.

The assumption of a first meridian is, however, entirely arbitrary; hence it is usual now, with every nation, to reckon that meridian which passes through their own royal observatory, their *first meridian*; thus, the French consider their first meridian to be that which passes through the Royal Observatory at Paris, &c. &c.

Every meridian may be said, in reference to the place through which it passes, to divide the surface of the sphere into two equal parts, called the eastern and western hemispheres.

The latitude of any place is an arc of its meridian, intercepted between the equator and the given place, and is named north or south, according as the given place is in the northern or southern hemisphere. As latitude commences at the equator, and terminates at the poles, the greatest possible latitude is obviously 90°.

Parallels of latitude, are small circles parallel to the equator. Every place on the surface of the earth may be supposed to have a parallel of latitude passing through it.

The difference of latitude between two places, is an arc of the meridian, intercepted between their respective parallels of latitude, showing how far one of them is north or south of the other; the greatest possible difference of latitude between two places is therefore 180°, and these places are the poles.

The co-latitude of any place, is the complement of the latitude of that place to 90°.

The longitude of any place, is that arc of the equator which is contained between the *first meridian* and the meridian of the given place; and it is denominated *east* or *west*, according as the given place is situate in the eastern or western hemisphere, in reference to the *first meridian*. Longitude, being reckoned both ways from the *first meridian*, till it reaches the opposite point of the equator, or that point which is intersected by the opposite part of the meridian, or as it is commonly called the *opposite meridian*, can never exceed 180°.

The difference of longitude between two places is an arc of the equator intercepted between their respective meridians, showing how far one of them is to the eastward or westward of the other. The difference of longitude between two places can never exceed 180°.

When the latitudes of two places are both north or both south, or their longitudes are both east or both west, they are said to be of the *same name*. But when the latitude of one is north and of the other south, or when the longitude of one is east and the other west, they are said to be of *different names*.

A ship in *north* latitude sailing *northerly*, or in *south* latitude sailing *southerly*, increases her latitude; but in *north* latitude sailing *southerly*, or in *south* latitude sailing *northerly*, she decreases her latitude: in the same manner, a ship in *east* longitude sailing *easterly*, or in *west* longitude sailing *westerly*, increases her longitude; but in *east* longitude sailing *westerly*, or in *west* longitude sailing *easterly*, she decreases her longitude.

PRACTICAL APPLICATION

OF THE FOREGOING PRINCIPLES AND DEFINITIONS.

To find the difference of latitude between two given places.

Rule.—If the latitudes are both of the same name, that is both north or both south, subtract the less from the greater, and the remainder will be the difference of latitude; but if one be north and the other south, add the two latitudes together, and their sum will be the difference of latitude.

Examples.

1. Required the difference of latitude between Greenwich Observatory and Air Point, in the Isle of Man.

Lat. of Air Point - - - - -	54° 26′N.
Lat. of Greenwich Observatory -	51 29 N.
Diff. of Lat. - - - - - -	2 57
	60
In Nautical Miles - - -	177

2. What is the difference of latitude between N. Cape in New Zealand, and Funchal in Madeira.

Lat. of N. Cape	34°	24′S.
Lat. of Funchal	32	38 N.
Diff. of Lat.	67	2
	60	
In Nautical Miles	4022	

To find the difference of longitude between two given places.

Rule.—When the given longitudes are of the same denomination, subtract the less from the greater; but when they are of different denominations, add them together. The sum or remainder will be the difference of longitude; observing however that as the difference of longitude signifies the *less* arc of the equator, intercepted between the two meridians, when the longitudes are of different denominations and their sum exceeds 180°, that sum must be subtracted from 360°, to find the difference of longitude.

Examples.

1. Required the difference of longitude between Botany Bay, and Cape Comorin on the Coromandel coast.

Long. of Botany Bay	151°	25′E.
Long. of Cape Comorin	77	30 E.
Difference of Long.	73	55
	60	
In Miles, or min. of long.	4435	

2. A ship from long. 172° W. sails westward, till she arrives in long. 148° 15′ E. required the difference of long. made good.

Long. left	172°	0′W.
Long. in	148	15 E.
Sum	320	15
	360	0
Diff. of Long.	39	45
	60	
In Miles, or min. of long.	2385	

Given the latitude left, and the difference of latitude, to find the lat. in.

Rule.—When the latitude left and the difference of latitude are of the same name, their sum will be the latitude in; but when they are of contrary denominations, their difference will be the latitude required. This latitude will always be of the same name with the greater quantity.

Examples.

1· A ship from lat. 38 42′ N. sailed in a northerly direction till she made her difference of lat. 417 miles, required her lat. in.

Lat. left - - - - - - - - - -	38°	42′N.
Diff. of Lat. 417m. = - - - - -	6	57 N.
Lat. in - - - - - - - - - -	45	39 N.

2. A ship from lat. 49° 58′ N. sails to the southward 83 miles, required her present latitude.

Lat. left - - - - - - - - - -	49°	58′N.
Diff. Lat. 83m. = - - - - - -	1	23 S.
Lat. in. - - - - - - - - - -	48	35 N.

Given the longitude left, and the difference of longitude, to find the longitude in.

Rule.—When the longitude left, and the difference of long. are of the same name, their sum will be the long. in, unless that sum exceed 180°, in which case that sum is to be subtracted from 360°, and the remainder will be the long. in, of a contrary name to the long. left. But when the long. left, and the difference of long. are of contrary denominations, their difference will be the long. in, of the same name with the greater quantity.

Examples.

1. Suppose a ship from 24° 36′ W. sails westward 536 miles, what is her present longitude.

Long. left - - - - - - - - -	24°	36′W.
Diff. of Long. 536m. = - - -	8	56 W.
Long. in. - - - - - - - - -	33	32 W.

2· A ship from Cape East, New Zealand, in long. 178° 40′ E. sails eastward till her diff. of long. is 405 miles, required her present long.

Long. left - - - - - - - - -	178°	40′E.
Diff. Long. 405m. = - - - -	6	45 E.
Sum - - - - - - - - - - -	185	25
	360	0
Long. in. - - - - - - - - -	174	35 W.

Examples for Exercise.

1. Required the difference of lat. and the diff. of long. between the Lizard and Air point, in the Isle of Man.

Answer.—Diff. of lat. 4° 30′=270 miles. Diff. of long. 49 miles.

2. Required the difference of lat. and difference of long. between Cape Clear and Java Head.

Answer.—Diff. lat. 58° 14′ =3494 miles.
Diff. of long. 114° 41′=6881 miles.

3. A ship from lat. 48° 2′ N. and long. 16 34′ W. sails between the S. and E. till she makes 149 miles diff. of lat. and 218 miles diff. of long. required her lat. and long. in.

Answer.—Her lat. in, is 45° 33′ N. and her long. in, 12° 56′ W.

4. A ship from lat. 64° 2′ N. and long. 3° 13′ W. sails between the S. and E. and finds she has made 204 miles diff. of lat. and 158 miles diff. of long. What lat. and long. has she arrived at?

Answer.—60° 38′ N. lat. and 35′ W. long.

INSTRUMENTS OF NAVIGATION.

The instruments used for directing the course, and estimating the rate of sailing of a ship at sea, are, the Mariner's Compass, the Log, and the Log Glasses.

THE MARINER'S COMPASS.

Is an artificial representation of the horizon, and is used by seamen to direct and ascertain the course of a ship at sea; one of the principal parts of this instrument is a circular card, the circumference of which is divided into 32 equal parts, by lines, called *points*, drawn from the centre, the spaces between these points are each divided into halves and quarters, termed *half points* and *quarter points*; the circumference is also divided into 360° consequently the angle comprehended between any two adjacent points is equal to 11° 15′.

The four principal points, denominated *cardinal points*, are the *north*, *south*, *east* and *west*. The north and south points are opposite to each other; and looking towards the *north*, the middle point between them (to the right) is the east, and the opposite point the west, these points therefore divide the circumference into four quadrants of 90° or 8 points each.

All the intermediate points of every quarter of the compass, are named according to their local position, with respect to the cardinal points which comprehend that quarter, and to one another; and since the nomenclature which has been adopted in the case of one quadrant will apply with a suitable change of terms, to the other three, it will be sufficient to shew in what manner the points of one of the quadrants (the north-east for example) have been named.

By referring, then, to the annexed figure of the compass card, it will be seen that the point of bisection between the north and east, from its equal relation to both, is called the *north-east** In like manner, the bisection of the arc between the north and north east, is called the *north* north-east, and that of the arc between the east and north-east, by a similar analogy, *east* north-east.

The bisection of each of the four resulting arcs, divides the quadrant into eight points, each of which is named by writing after the north, east, and north-east points, the term *by* (used in sense of proximity) with one or other of the cardinal points annexed, according as the point to be named is contiguous to the one or to the other. Thus, the point adjacent to N. E. towards the north is called N. E. by N., while the one similarly placed towards the E. is termed N. E. by E.; by a like mode of procedure, the point next to the north towards the east, is called N. by E., and that next to the east towards the north, E. by N.

With regard to numerical order, these points are reckoned from the north, and also from the south towards the east and west, as is shewn in the following

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* It is scarcely necessary to observe, that on the compass card the initials only of the different points are inserted, instead of the words.

TABLE

Of the angles made by every point of the compass with the meridian.

North.	South.	Points.	°	′	North.	South.
		¼	2	49		
		½	5	37		
		¾	8	26		
N. by E	S. by E.	1	11	15	N. by W.	S. by W.
		1 ¼	14	4		
		1 ½	16	52		
		1 ¾	19	41		
N.N.E.	S.S.E.	2	22	30	N.N.W.	S.S.W.
		2 ¼	25	19		
		2 ½	28	7		
		2 ¾	30	56		
NE. by N.	S.E. by S.	3	33	45	N.W. by N.	S.W. by S.
		3 ¼	36	34		
		3 ½	39	22		
		3 ¾	42	11		
N.E.	S E	4	45	0	N.W.	S.W.
		4 ¼	47	49		
		4 ½	50	37		
		4 ¾	53	26		
N.E by E.	S.E. by E.	5	56	15	N.W. by W	S.W. by W.
		5 ¼	59	4		
		5 ½	61	52		
		5 ¾	64	41		
E.N.E.	E S.E.	6	67	30	W.N.W.	W.S.W.
		6 ¼	70	19		
		6 ½	73	7		
		6 ¾	75	56		
E. by N.	E by S.	7	78	45	W. by N.	W. by S.
		7 ¼	81	34		
		7 ½	84	22		
		7 ¾	87	11		
	East	8	90	0	West	

The compass card is attached to a magnetic bar, commonly called the *needle*, placed immediately below it, in the direction of the north and south line, the north point of the card being laid upon the north end or *pole* of the needle.

The needle is made of good steel moderately tempered. and magnetized artificially, to a maximum state, whereby it acquires the *peculiar* property of always pointing in a particuliar direction, generally not far from that of the meridian. The needle having a small socket in the centre, is supported at that point by a pivot on which it turns freely, and being acted upon by the magnetic attraction, each point respectively shews the corresponding magnetic points of the horizon.

The supporter, on which the middle of the needle rests, is fixed to the bottom of a brass or wooden hemispherical box or bowl, the mouth of which is covered with a plate of glass, to protect the card from agitation by the wind, and the box, containing the needle and its card thus supported, is retained in a horizontal position, by means of two concentric rings called gimbals, which are connected with each other by pivots diametrically opposite; the outer ring being attached to a square box also by pivots, in such a manner, that the line which joins them is at right angles to the line joining the two former, the rings having an easy motion on the pivots by which they are supported; to whatever motion the external box is exposed, the internal one remains with its surface always in a horizontal position.

The ship's course is indicated by the angle which the keel makes with the needle, and this is more distinctly pointed out, by means of a vertical line drawn in the inside of the circular box, and in steering a particular course, the corresponding point in the compass *card* must be kept, by the management of the steersman, to bear steadily upon it. This vertical line is commonly called the *lubber's point.*

The needle does not always point to the true north point of the horizon, and its deviation from that direction is called *the variation of the compass,* the quantity and direction of which variation at any place, may easily be determined, by astronomical observations, in a manner hereafter to be taught; it is sometimes estimated in degrees &c., but more frequently in points.

Thus, if the north end of the needle points to the N.N.W. point of the horizon, the variation of the compass is said to be two points westerly, and the N.N.E. point of the compass will coincide with the meridian; the east point of the compass with the E.N.E. point of the horizon, and so on. But if the north point of the compass is directed to the N.E. by N. point of the horizon, the compass is then said to have three points easterly variation, and the N.W. by N. point of the compass will coincide with the meridian, &c.

The allowances to be made for the variation of the compass at sea, will however be more particularly explained in their proper place.

The bar or needle on being magnetized, not only acquires the property of pointing in a particular direction, but, though accurately balanced before, it loses its horizontal direction, and becomes inclined to the horizon.

This inclination of the needle, called *the dip of the needle,* is different in different places, the north end dipping in north magnetic latitude, and the south end in south magnetic latitude; the magnetic latitude being reckoned from the magnetic equator, or that part of the earth where the dip is nothing; and since the magnetic equator is an irregular curve, not coinciding throughout with the earth's equator, the magnetic latitudes do not every where correspond with the geographical latitudes.

In order to counteract the effects of the dip, and to adjust the card to a horizontal position, needles properly fitted up for mariner's compasses, have a sliding weight applied to them, which acts with greater or less force, according as it is at a greater or less distance, from the centre of the needle.

DEVIATION OF THE COMPASS.

Besides the variation of the compass, and the dip already described, the needle is also subject to a deviation from the *magnetic meridian*. called *the local deviation,* caused by the influence of the iron work, guns, anchors, &c. in and about the vessel; whereby, instead of its pointing exactly to the magnetic north and south, it is drawn from this position by the magnetic attraction of the iron: in merchant vessels, in general, this effect is much less considerable than in men of war and steam vessels, where the guns, tanks, shot, &c. in the former, and the engines and paddles in the latter, produce a much greater disturbance of the needle, than is found to exist in most other vessels.

The amount of this deviation varies very considerably under different circumstances; in almost all vessels, it is greatest with the ship's head towards the east and west, and least, or nearly nothing, with the head towards the north and south; it also varies with the dip, being less in those parts of the world where the dip of the needle is least and increases as the dip increases, either to the north or south, having been found, with a dip of about 80°, to amount to no less than 30° or 40°, it also changes *its direction* when the dip of the needle is reversed, thus, upon a ship from north magnetic latitude arriving in south, the local deviation assumes an opposite direction to that it previously had.

The best practical methods of determining the amount of the local attraction on board are as follows;—first by comparing, by a compass on board, the bearing of a distant object on shore, whilst the vessel is swung round through all the points of the compass; it is necessary that the object on shore should be some miles distant, in order that the parallax of the vessel, in the circuit she makes in swinging round, be so small as to subtend an insensible angle at the object.

The distance from the object should vary from five to ten miles, according as the ship is moored, for could she move as it were on a pivot the observations might be considered as taken from a single spot. After the observations are once made and the deviation determined, great care should be taken that no alteration takes place in the disposition of the iron by which the compass is surrounded. Taking on board the davits on going to sea, has been known to produce a serious change in the deviation.

Having selected an object on shore, and determined its true bearing from the ship, observe the bearing of the object as the ship's head arrives at the several points of the compass. The difference between the observed and the correct magnetic bearing, will be the local deviation corresponding to the position of the ship's head at the instant of observation.

The deviation thus found is to be called *east*, when the north end of the needle is drawn to the eastward, or to the right-hand; and *west* when it is drawn westward, or to the left-hand; and the correction arising from the deviation, is to be applied exactly in the same manner as the variation is applied; that is, supposing the eye to be in the centre of the compass card, and looking along the point in question, the *east* deviation must be applied to the *right* hand, and the *west* deviation to the *left* hand.

The bearings should be immediately noted in a Table arranged in the following form.

When the deviation is to the eastward, it is marked —, when to the westward +.

True magnetic bearing of the object from the ship, N. 17°E.*

Ship's Head,	Observed bearing of Object,	Local Deviation	Ship's Head,	Observed bearing of Object.	Local Deviation
North	N 18° E	+1°	South	N 14° E	—3°
N.N.E.	N 16 E	—1	S.S.W.	N 17 E	—0
N.E.	N 14 E	—3	S.W.	N 19 E	+2
E.N.E.	N 13½ E	—3½	W.S.W.	N 22 E	+5
East	N 12 E	—5	West	N 24 E	+7
E.S.E.	N 9½ E	—7½	W.N.W.	N 25 E	+8
S.E.	N 10 E	—7	N.W.	N 23 E	+6
S.S.E.	N 13 E	—4	N.N.W.	N 20½ E	+3½

The effect of the local deviation on the needle thus found, should be placed in convenient order for correcting the courses; or, what would still more effectually prevent error in applying the correction, a table of the points ready corrected might be made, and placed either in the binnacle or some ready place of reference.

By the above observations it is evident, that if a ship were apparently steering S.E. by the compass, she would be actually steering 7° to the southward of that point, or S.E.⅝S. and in working the day's work, the —7° must be applied to that course; but if on the other tack she should lie up north, only 1° would be the correction to be applied, and that with the contrary sign.

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* This Table, which is here in an abridged form, is extracted from a Pamphlet published by the Admiralty.

Having shewn the means by which the seaman may attain the desired object with a single compass, we will now describe the second method, which, however, requires the assistance of two compasses and two observers. The two compasses selected for the operation should precisely agree with each other. One of them mounted on a tripod stand is to be taken on shore, at a short and convenient distance from the ship, and so placed as to be easily seen from the other compass, which remains on board in its proper position in the binnacle, from whence the principal observer will watch the progress of the ship's head, and by some preconcerted signals he will communicate the instant of his making each observation to his assistant on shore.

Care should be taken to check the rapidity of the ship's swinging, and to steady her head at the moment of observation; then commencing at any point on which the ship's head happens to be, the bearing of the shore compass is taken, and at the same moment, by signal, the bearing of the compass on board is taken, and each observation is registered. In this manner the ship's head is carried through the different points of the compass, and the observations are placed in a tabular form, somewhat like the last; the *difference* between the observations made on shore and on board, forming a column of corrections to be applied as before to the respective courses.

Great care should be taken, previously to making these experiments, that the compasses, caps, pivots, &c. are in good order, and that the two compasses agree when free from local influence.

And it should be remembered, that all observations on board should be made *from the binnacle*, as an alteration in the position of the compass on board, will, from the very nature of the local deviation, alter the bearing of every object taken with it.

Different plans have been devised for correcting the deviation, but that proposed by Professor Airy, has been universally adopted in the merchant steam vessels; this is effected by placing powerful magnets in the deck near the compass, by which the needle is drawn round to its proper position; but the method of correcting the courses, as explained before, is to be preferred, where sufficient attention can be given by those on board. The magnets may, in some instances, be found to lose their power, but the experiment has now had such full trial, that with ordinary care, and an occasional examination, by swinging the ship round and comparing her compasses with a good azimuth on shore, there is little chance of the continuance of a sensible error.*

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* For a fuller account of the Compass, and the various effects produced on it, by the disposition of the iron on board, and other causes, I would refer the student to Captain Johnson's valuable work on the Deviation of the Compass.

THE LOG AND GLASSES.

These are instruments used for ascertaining the velocity of a ship's motion, or what is commonly called, her rate of sailing.

The Log, or Log ship, consists of a quadrantal-shaped piece of wood, a quarter of an inch thick, and of about five inches radius; the curved part of which, is loaded with lead, so as to sink the whole just below the surface of the water, and, at the same time, to keep it in an erect position. There are commonly two holes in the log, through one of which, one end of the slings is rove and knotted; the other is to receive a peg of wood or bone, which is attached to the other end of the slings.

The log-line is bent on to the bight in such a manner, as to have the peg end of the slings, the shortest, that, upon being checked, when the operation of heaving the log has been effected, the peg, which when the log is hove, is pressed firmly into the hole appropriated to it, may come out, and the log be more readily hauled in.

The inner end of the log-line is fastened to the spokes of a reel, on which the line is wound, and this reel, turning freely, suffers the line to run off, without checking or bringing home the log.

The log-line is about 120 fathoms in length, and, at a distance varying in different lines, from 10 to 20 fathoms from the log-ship, a bit of bunting rag, and sometimes of black leather, is fixed, to mark off a sufficient quantity of line, called *stray line,* to let the log go clear of the ship before the line is counted.

From this point to the inner end, the line is divided into equal portions called *Knots;* at each of which, a bit of string, with the number of knots upon it, is put through the strands.

The length of a knot should bear the same proportion to a nautical mile, that the space of time indicated by the glass bears to an hour; hence the length of a knot, adapted to a glass of a given number of seconds, is easily determined.

The nautical mile, being very nearly 6,080 feet,* and the hour consisting of 3,600 seconds, let it be required to find the length of a knot for a glass of 30 seconds,—

3600 : 30 : : 6080 : 50·7, or 50ft. 8in.

The length of the knot for a glass of 28 seconds,—

3600 : 28 : : 6080 : 47·3, or 47ft. 3½in;

and, in a similar way, the length of a knot for any other glass may be determined.

The glass running 28 seconds is generally used, but when the ship's rate of sailing exceeds 8 knots, a quarter minute glass, or glass running 14 seconds, is sometimes employed; in which case, the common knots run off must be doubled, or a log-line with half knots used.

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[*] A nautical mile, corresponding to the mean radius of the Earth, is 6076 feet, and the length of a knot for a half-minute glass is 50 ·63 feet, or 50ft. 7½in; hence if the knot be divided decimally every tenth will be 5 feet and ¾ of an inch.

The knot is supposed to be divided into eight equal parts or fathoms, and that these may be just 6 ft. each, it is common to allow 48 ft. to a knot; but whatever length may be assigned to the knot, as the log-line and glasses are frequently affected by alterations in the heat or moisture of the weather, &c. they should be very frequently examined, and the ship's run corrected for any errors that may be discovered in the instruments.

The distance between the knots may be easily measured with a rule, or compared with the distance between the nails placed on the deck for that purpose: and the half minute glass may be examined, either by a watch with seconds, or by the vibrations of a plummet fastened to a line 39⅛ inches long, from the point of suspension to the centre of the plummet; a vibratory motion being imparted by the hand to the plummet, the number of its vibrations, performed while the glass is running out, will be the number of seconds measured by the glass.

The following rules have been given for correcting the ship's run, on account of the errors in the log line and half minute glass.

CASE I.

The distance sailed by the log and the seconds run by the glass being given to find the true distance, the line being supposed right.

Rule.—Multiply the distance given by the log by 30, and divide the product by the seconds run by the glass, the quotient will be the true distance.

Examples.

1. The hourly rate of sailing by the log is 7 knots, and the glass running out in 32 seconds, required the true rate,

Rate of sailing per log 7 knots
30

32) 210 (6·5 the true rate nearly.

2. Suppose the distance run by the log is 84 miles, and the glass runs 27 seconds, what is the true distance sailed?

Distance per log 84 miles
30

27) 2520 (93⅓ true distance.

CASE II.

Given the distance sailed by the log, and the measured interval between two adjacent knots in the line, to find the true distance, the glass running exactly 30 seconds.

Rule.—Multiply the distance given by the log, by the measured interval, and divide the product by 48,* the quotient will be the true distance.

Examples.

1. Suppose the distance sailed by the log to be 8 knots, and the measured interval between two adjacent knots to be 51 ft. what is the true rate of sailing ?

Distance per log .... 8 knots
Measured interval .... 51 feet

48) 408 (8·5 true rate.

2. The distance run, as shown by a line which measures 43 ft. between two adjacent knots, is 106 miles, required the true distance.

Distance per log........ 106 miles
Measured interval ...... 43 feet

48) 4558 (94·96 true distance.

Case III.

Given the length of a knot, the number of seconds run by the glass and the distance sailed by the log, to find the true distance.

Rule.—Multiply the distance run by the log, by the length of a knot, to which annex a cipher, and divide the product by 16 times the seconds run by the glass, the quotient will be the true distance.

Examples.

1. The distance sailed by the log, is 221 miles, the measured length of a knot is 41 feet, and the glass runs 33 seconds, required the true distance.

Distance sailed by the log..... 221 miles
Measured length of knot 41

Seconds run by the glass 33 × 16 -528) 90610 (171·6 true dist.

2. The distance sailed by the log 184 miles, the measured length of a knot is 45 feet, the glass running 34 seconds ; what is the true distance ?

Distance run by the log ..... 184 miles
Measured length of knot 45

Seconds run by the glass 34 × 16 = 544) 82800 (152·2 true dist.

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* Those who use the knot of any other length, must divide by that measure accordingly.

PLANE SAILING.

In Plane Sailing, the earth's surface is considered as an extended plane, the meridians are conceived to be parallel straight lines, the parallels of latitude to be lines cutting the meridians at right angles, and the length of a degree on the meridian, and in the parallels of latitude, to be every where equal to that of a degree on the equator. This sailing involves the four following things,—*course, distance, difference of latitude,* and *departure.*

The course, is the angle the ship's track makes with the meridian, it is expressed either in points or degrees; thus, the course of a ship sailing in a direction half way between the north and east, may be expressed either as 4 points, or 45°.

The distance, is the number of miles that a ship sails, on a direct course between any two places.

The difference of latitude, is the arc of the meridian intercepted between the parallel of the place left, and that of the place arrived at.

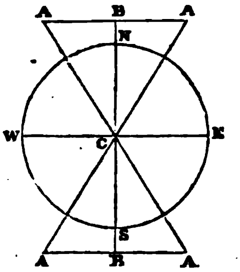
The departure, is the distance of the ship from the meridian of the place sailed from, reckoned on the parallel of latitude arrived at.

If a ship's course be due north or due south, she sails on a meridian, and therefore makes no departure; hence the distance run will be equal to the difference of latitude.

If her course be due east or due west, she sails either on the equator, or on some parallel of latitude, and consequently makes no difference of latitude; and the distance run will therefore be equal to the departure.

But if her course be neither due north or south, nor due east or west, it must be toward some intermediate point of the horizon, she will, consequently, make both difference of latitude and departure; and the track she describes, will become the hypothenuse of a right-angled triangle, of which the difference of latitude and departure are the legs. Thus in the annexed figure:—

Let NESW represent the horizon of the place C, from which the ship sails, CA the point of the compass she sails on, and A the place arrived at; then WE represents the parallel of latitude left, and AA the parallel of latitude in. Now it is obvious, that in whatever quarter of the compass the ship sails, BC becomes the difference of latitude, AB the departure, and CA the distance run; and that these three in every case form a right-angled triangle.



Hence it follows that Plane Sailing, in Navigation, is nothing more than the practice of right-angled plane trigonometry; calling the hypothenuse the *distance* sailed, the perpendicular the *difference of latitude*, the base the *departure*, and the angle opposite the base, the *course*.

When the course is 4 points, or 45 degrees, the difference of latitude and departure are equal.

When the course is *less* than 4 points, or 45 degrees, the difference of latitude exceeds the departure; but when it is *more* than 4 points, or 45 degrees, the departure exceeds the difference of latitude.

Case I.

The course and distance given, to find the difference of latitude and departure.

Example.

A ship from latitude 20° 32′N. sails N.W. by N. 768 miles; required the latitude in, and departure made good.

By Inspection.

Enter Table 1, with the course, 3 Points, at the top, then (the given distance exceeding the limits of the Table,) take out, first, the difference of latitude and departure, found in their respective columns, corresponding to 300 miles in the distance column, these being multiplied by 2, will give the difference of latitude and departure, answering to a distance of 600 miles, To these products, add the difference of latitude and departure, opposite to 168 in the distance column, for the whole difference of latitude and departure required.*

The operation will then stand as follows:

$$\left.\begin{array}{l}\text{Cou.N.W.bN.}=3\text{ pts.}\\ \text{Distance - 768 miles}\end{array}\right\}\begin{array}{c}\text{by}\\ \text{Table 1.}\end{array}\left\{\begin{array}{l}\text{Diff. lat.}249\cdot4\times2+139\cdot7=638\cdot5\text{m}\\ \text{Departure }166\cdot7\times2+93\cdot3=426\text{m.}\end{array}\right.$$

By Calculation.

To find the diff. lat.

As rad	0·00000
: dist. 768 m.	2·88536
:: cos. cou. 3 pts.	9·91985
: diff. lat. 638·6m	2·80521

To find the departure.

As rad.	0·00000
: dist. 768 m.	2·88536
:: sin. cou. 3 pts	9·74474
: dep. 426·7m.	2·63010

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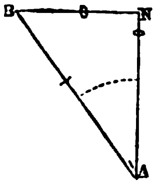
* The Explanation to Tables 1 and 2 being sufficiently explicit, particular directions for resolving the various cases by this method, will in future be omitted as unnecessary; and the operation only will be retained. In working by Inspection (the only method generally used at sea,) it will be found a convenient practice to unite the *given* parts together by a brace, and also the *required* parts by another brace, in the manner shewn above.

To find the latitude in.

Latitude left - - - - -		20° 32′N.
Diff. of lat. 638·6 m. -	=	10 39 N.
Lat. in - - -		31 11 N.

By Construction.



Draw AN indefinite,
make ∠ A (∠ of course) = 3 points,
draw AB (distance) = 768,
draw BN perp. to AN,
then will
AN the difference of latitude = 639m. nearly; and
BN the departure = 427 m. nearly.

Case II.

The course and difference of latitude given, to find the distance and departure.

Example.

A ship from latitude 45° 25′ N. sails N.W.bW.½W. until she arrives in latitude 46° 55′ N.; required the distance run, and departure made good.

To find the difference of latitude.

Latitude left - - - - -	45° 25′N.
Latitude in - - - - - -	46 55 N.
Difference of latitude - -	1 30 = 90 m.

By Inspection.

Cou. N.W.bW.½ W. = 5½ pts.	by Table 1	Distance 191 m.
Difference of latitude 90 m.		Departure 168·5 m.

By Calculation.

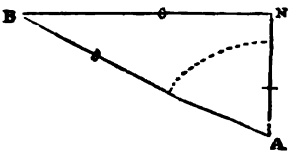
To find the distance.

As cos.cou. 5½ pts. co.ar.	0·32661
: diff. lat. 90 m.	1·95424
:: rad.	10·00000
: dist. 190 m.	2·28085

To find the departure.

As cos. cou. 5½ pts. co. ar. .	0·32661
: diff. lat. 90 m.	1·95424
:: sin. cou. 5½pts.	9·94543
: dep. 168·4 m.	2·22628

By Construction.



Draw AN (diff. of lat.) = 90,
on N draw BN indefinite, perp. to AN,
make the ∠ A (∠ of course) = 5¼ points,
draw AB, cutting BN in B,
then will
AB, the distance, = 191 m.; and
BN, the departure, = 168·4 m.

CASE III.

The course and departure given, to find the distance and latitude in.

Example.

A ship from latitude 52°N. sails S.E.bE. ½ E. until she makes her departure 254 m.; required the distance run, and latitude in.

By Inspection.

Cou. S.E.bE.½E. = 5½ Pts.	} by	{ Distance	288 m.
Departure - - 254 m.	} Table 1.	{ Diff. of lat.	135·8 m.

By Calculation.

To find the distance.

As sin. cou. 5½ pts. (co. ar.)	0·05457
: dep. 254m.	2.40483
:: rad.	10·00000
: dist. 288m.	2·45940

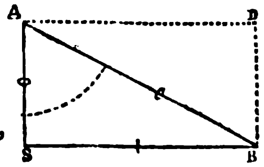
To find the diff. lat.

As sin. cou. 5½ pts. co.ar.	0·05457
: dep. 254m.	2·40483
:: cos. cou. 5½ pts.	9·67339
: diff. lat. 135·8m.	2·13279

To find the latitude in.

Latitude left.	52°	0′N.
Diff. lat. 135·8m.	2	16 S.
Latitude in.	49	44 N.

By Construction



Draw AS indefinite,
make the ∠ SAB (∠ of course) = 5½ points,
draw the line AB indefinite,
draw AD perp. to AS = departure, 254,
from D draw DB, parallel to AS, and cutting AB in B,
through B draw BS, parallel to AD,
then will,
AB the distance = 288m.; and
AS the diff. of lat. = 135·8m.

CASE IV.

The distance and difference of latitude given, to find the course and departure.

Example.

A ship from lat. 57° 20′ N. sails 98 m. between the N. and S. and finds she has made 82 miles difference of latitude; required her course steered, and departure made good.

By Inspection.

Distance 98 m. } by Table 2. { Cou. N. 33° E. or, N.E.bN. nearly
Diff. lat. 82 m. } { Departure 53·4m.

By Calculation.

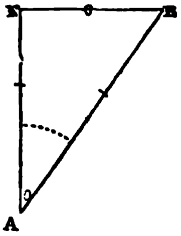
To find the course.

As dist. 98 co.ar.	8·00877
: rad.	10·00000
:: diff. lat. 82m.	1·91381
: cos. cou. 33° 12′.	9·92258

To find the departure.

As rad.	0·00000
: dist. 98	1·99123
:: sin. cou. 33° 12′.	9·73843
: dep. 53·66.	1·72966

By Construction.



Draw AN (diff. of lat.) = 82m,
through N draw NB, indefinite, perp to AN,
with the distance 98 in the compasses, and one foot in A,
cut the line NB in B,
draw the line AB,
then will
∠ NAB, the ∠ of course = 33° 12′; and
NB the departure = 53° 7′

CASE V.

The distance and departure given, to find the course, and difference of latitude.

Example.

A ship from latitude 38° 20′S. sails between the S. and W. 540 miles, until she makes her departure 384 miles; required her course steered, and latitude in.

By Inspection.

Dist. 540÷10=54 } by Table 2 { Course, S. 45 W. or S.W
Dep. 384÷10=38·4 } { Diff. lat. 38·2 × 10=382m.

By Calculation.

To find the course.

As dist. 540 co.ar.	7·26761
: rad.	10·00000
:: dep. 384............	2·58433
: sin cou. 45° 20′	9·85194

To find the diff. lat.

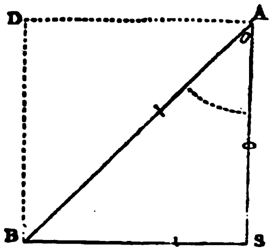
As rad.	0·00000
: dist. 540m...........	2·73239
:: cos. 45° 20′	9·84694
:: diff. lat. 379·6	2·57933

To find the latitude in.

Latitude left	38°	20′S.
Diff. lat. 379·6m. .... =	6	20 S.
Latitude in	44	40 S.

By Construction.

Draw the line AB indefinite,
from A, perp. to AS, draw AD = 384, the departure
draw DB indefinite, parallel to AS,
with the distance 540 in the compasses, and one
foot in A, cut the line DB, in B.
draw the line BA,
draw BS parallel to AD,
then will
∠ BAS, the ∠ of course = 45° 20′; and
AS, the diff. of lat. = 379·6.



CASE VI.

The difference of latitude and departure given, to find the course and distance.

Example.

A ship from 44° 50′N. sails between the S. and E. until her departure is 64 m. and then, by observation, is found to be in latitude 42° 55′N.; required her course steered, and distance run.

To find the difference of latitude.

Latitude left	44°	50′N.
Latitude in	42	55 N.
Difference of latitude.	1	55 = 115m.

By Inspection.

Diff. lat. 115m. } by { Course S. 29 E. or about S.S.E.½E.
Departure 64m. } Table 2. { Distance 132m.

By Calculation.

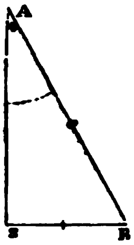
To find the course.

As diff. lat, 115m. co,ar....	7·93930
: rad.	10·00000
:: dep. 64m.............	1·80618
: tang. cou. 29° 6'.....	9·74548

To find the distance

As rad.	0·00000
: diff. lat. 115m.	2·06070
:: sec. cou. 29° 6'.....	10·05860
: dist. 131·6m.........	2·11930

By Construction.



Draw AS (diff. of lat,) = 115,
on S, perp. to AS, draw BS = 64, the departure,
join AB,
then will
∠BAS, the ∠ of course = 29° 6'; and
AB, the distance = 131·6m.

Examples for Exercise.

1.—A ship from latitude 54° 4'N. sails S.W.byW. 297m.; required her latitude in, and departure made good.

Answer.—Latitude in, 51° 19'N. departure, 246·9m.

2. A ship from latitude 17° 25'N. sails N.E,½E. until her difference of latitude becomes 420m.; required her distance run, and departure made good.

Answer.—Distance 662m. departure, 511·8m.

3. A ship from latitude 52°N. sails S.E. by E.½E. until she has made 245m. of departure; required her distance run and latitude in.

Answer.—Distance, 277·8m. latitude in, 49° 49'N.

4. A ship from latitude 37° 3'N. sails between the S. and W. 480m. until her difference of latitude is 384m.: required her course steered, and departure made good.

Answer.—Course S. 36° 52'W. departure 288m.

5. A ship from latitude 32° 35'N. sails 488m. between the N. and W. until her departure is 405m.; what course has she steered, and what latitude is she in?

Answer.—Course N. 56°W. latitude in, 37° 7'N.

6. A ship from latitude 34° 29'S. sails south-westward, till she arrives in latitude 36° 34'S. and has made 75m. departure; required the course steered, and distance run.

Answer.—Her course is S. 30° 58'W. and the distance 145·8m

TRAVERSE SAILING.

A TRAVERSE is an irregular track, which, from contrary winds and other causes, a ship describes during a day's run, and being composed of several different courses, it is named a COMPOUND COURSE, the resolving which into a single course and distance, technically called the course and distance made good, is termed *working a traverse,* and constitutes what is denominated Traverse Sailing.

A traverse, like a case in Plane Sailing, may be resolved by inspection, by logarithmic calculation, and by geometrical construction.

For the two first methods, the difference of latitude and departure made good, must be found as follows;—draw out a table (as in Example 1,) and divide it into six columns, by vertical lines, these columns are to be headed as follows:—the first column on the left, to be headed Courses; the next toward the right, Distances; over the two following columns write Diff. of lat. marking the first with an N. to signify north, and the second with an S. to denote south; over the two last columns, write Departure, putting an E. over the first, and a W. over the second, to indicate east and west. Begin at the left, and write the courses and distances one under the other, in their respective columns. Find the difference of latitude and departure in Table 1, or 2, according as the courses are given in points or in degrees, (as in Case 1 in Plane Sailing,) and write them in their proper columns; that is, set the difference of latitude in the column marked S, when the course is southerly, and in the column N. when the course is northerly; the departure when westerly, in the column W. and when easterly, in the column E.; add the different latitudes in each column, set the lesser of the two sums under the greater, and take their difference, also do the same with the departures; these differences are the difference of latitude and departure made good in the whole traverse, each taking the name of the column it stands in.

With this difference of latitude and departure, the course and distance made good are to be found by inspection, or by calculation, as in Case 6, of Plane Sailing.

To resolve a Traverse by geometrical construction, proceed as follows; with the chord 60° describe a circle, and draw the meridian, or north and south line. Lay off, on the circumference of the circle, the various courses sailed, numbering them 1, 2, 3, &c. in their regular order. Upon the first course set off the first distance, marking its termination; from this point, and parallel to the second course, draw the second distance run, of its proper length, marking its termination as before; from this point, and parallel to the third course, draw the third distance, determining its length and marking its extremity, and thus proceed till all the courses are drawn. Produce the meridian as far as is requisite, and draw a line from the termination of the last distance, perpendicular to the meridian; which line will represent the departure made good; a line drawn from the same point to the centre of the circle, will, in like manner, represent the distance made good; the difference of latitude made good, is represented by the part of the meridian intercepted between the centre of the circle and the intersection of the meridian by the departure. The course made good, is the angle formed by the line indicating the distance with the meridian.

Example.

A ship from the Lizard, in latitude 49° 58′ N. sails S.S.W. 54 m. W. by S. 39m. N.W. by N. 40m. N.E. by E. 69m. N.N.W. 60m. Required her direct course, and distance made good, and her latitude in.

Proceeding according to the above directions, the difference of latitude and the departure made upon each course, and also the total difference of latitude and departure made good, will stand as in the annexed Table.

TRAVERSE TABLE,

Courses.	*Dist.*	*Diff. Lat.*		*Departure.*	
		N.	S.	E.	W.
S.S.W.	54	....	49·9	...	20·7
W b S.	39	....	7·6	....	38·3
N.W. b N.	40	33·3	....	....	22·2
N.E. b E.	69	38·3	....	57·4	....
N.N.W.	60	55·4	....	....	23·0
		127·0	57·5	57·4	104·2
		57·5			57·4
Diff. Lat.		69·5		Dep.	46·8

Then,—

To find the Latitude in.

Lat. of the Lizard........	49°	58′N.
Diff. of lat. 69·5m..... =	1	10 N.
Latitude in............	51	8 N.

To find the course, and distance made good.

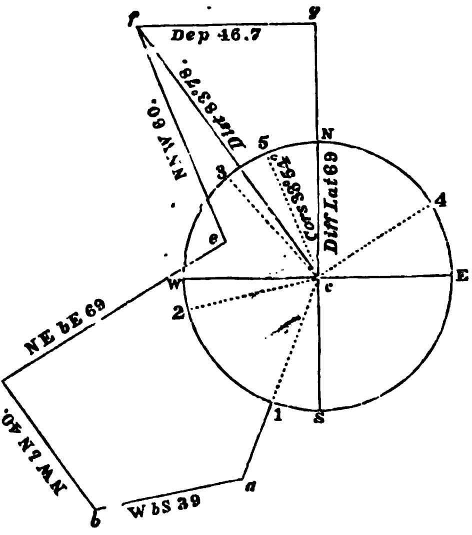
By Inspection.

Diff. lat. 69·5m. Departure46·8m.	by Table 2.	Course N. 34 W. or N.W.bN. Distance, 84m.

By Calculation.

To find the course,		To find the distance.	
As diff. lat. 69·5 co. ar. ...	8·15801	As rad.	0·00000
: rad.	10·00000	: diff. lat. 69·5m.	1·84199
:: dep. 46·8m.	1·67025	:: sec. cou. 33° 57′.....	10·08117
: tang. course 33° 57′...	9·82826	: dist. 83·78m.	1·92316

By Construction.



Draw the circle NESW, with the meridian lines NS, and the east and west line EW, crossing the former at right angles; then, according to the foregoing directions for resolving a Traverse by Construction, proceed to dot in the several rhumbs, or points of the compass sailed upon, numbering them according to the order of the courses; then lay off the distance run upon each course as above, beginning with the first course, and continuing to the last, and the compound track described by the ship will be as shown in the annexed figure; the first course being from *c* to *a*, the second from *a* to *b*, the third from *b* to *d*, the fourth from *d* to *e*, and the fifth from *e* to *f*, which point is the place of the ship at the end of the traverse.

Produce the meridian SN indefinitely, towards *g*,
draw *f g* perpendicular to *c g*, and
join *f c*,
then will
∠ *f c g*, the ∠ of course made good = 33° 57′
f c, the distance made good = 83° 78m.
g c, the difference of latitude = 69·5m.
f g, the departure = 46·8m.

Examples for Exercise.

1. A ship from latitude 52° 17′S. sails W.N.W. 17m. W. ½ S. 25m. S.S.W. 32m. S.W. ½ S. 64 m. N.W.b.N. 26 m. and N.N.W. 30m.; required her course, and distance made good, and her present latitude.

Answer.—Course, S. 77° 5½′W. or W.b.S. distance, 122·1 m. latitude in, 52° 43′S.

2. A ship in latitude 69° 26′N. sails N.N.E. 38m. E. 48m. E.S.E. 72m. S.E.b E. 58m. S.S.W. 50m. and S.W. 64m.; required her course, and distance made good, and her latitude in.

Answer.—Course, S. 44° 9′E. or S.E. distance, 161·9 m.
latitude in, 67° 30′N.

3. A ship from latitude 36° 22′N. sails as follows, S.S,W. 50m. S.bW. ¼W. 69m. N.E.b.E. 25m. W.b.S. 71m. S.W.bW. 85m.; required her latitude in, and her course, and distance made good.

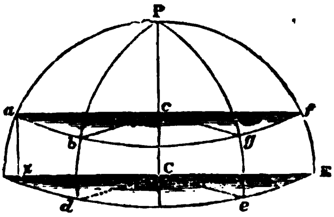
Answer.—Latitude in, 33° 43′N. course, S. 44° 51′ or S.W.
distance, 224·8m.

PARALLEL SAILING.

In the preceding problems the meridians have been considered as so many parallel lines, and consequently, a degree on any parallel of latitude equal in length to a degree on the equator; and since the rhumb on which a ship sails, cuts all the meridians at equal angles, the conclusions thus obtained are correct so far as course, distance, difference of latitude and departure only are concerned: but in all problems involving the consideration of *longitude*, it will be necessary to advert to the spherical form of the earth; such problems constitute what are called Globular Sailings.

PARALLEL SAILING is the method of finding the distance between two places situated on the same parallel of latitude, their difference of longitude known; or of finding the difference of longitude, corresponding to the meridional distance, when a ship sails due east or west.

As a thorough knowledge of the principles upon which Parallel Sailing is founded, will greatly assist the student in acquiring correct notions of the principles of Globular Sailings in general, we shall illustrate the subject by a figure.



Let c be the centre of the sphere. P the pole, P *a* W, P *b* *d*, P *g* *e*, and P *f* E, be arcs of meridians; also let *a* *b* represent a distance run on the parallel *abgf*, and W *d*, the corresponding difference of longitude on the equator, W *d* *e* E.

In the plane of the parallel *a* *b* *g* *f*, draw *a* c, *b* c meeting P C, the semi-axis, of the sphere in c, and in the plane of the equator W *d* *e* E, draw W C, *d* C, meeting the centre of the sphere in C; then the ∠ *a* *c* *b*, is equal to the ∠ W C *d*, therefore the arcs *a* *b*, W *d*, are similar.

Now the circumference of circles, and similar arcs of circles, are in direct proportion to each other, respectively as their radii, hence it follows, that the circumference of the parallel *a b g f*, is to the circumference of the equator, W *d e* E, as *a c* is to W C, and also that the arc *a b*, is in the same proportion to the similar arc W *d*.

But W *d* is the latitude of the place *a*, or parallel *a g b f*, and *a x* is the sine of the arc W *a*, and *a c* is the sine of the arc *a* P, and consequently it is the co-sine of the arc *a* W, that is, it is the *co-sine of the latitude*, and W C is the *radius* of the sphere.

Hence it follows, that in sailing upon any parallel of latitude, or directly east or west;

rad. (W C) : diff. long. (W *d*) : : cos. lat. (*a c*) : mer. dist. (*a b*)
or, cos. lat. (*a c*) : mer. dist. (*a b*) : : rad. (W C) : diff. long. (W *d*)
or, diff. long. (W *d*) : rad. (W C) : : mer. dist. (*a b*) : cos. lat. (*a c*)
also,
cos. any lat. : mer. dist. in that lat. : : cos, any other lat. : mer.dist. in that other lat.

Hence it follows, that if the base of a right-angled plane triangle represent the meridian distance, on a parallel whose latitude is the measure of the acute angle at the base of the triangle, and consequently whose co-latitude is the angle opposite to the base, the hypothenuse will represent the distance of the meridians at the equator, or their difference of longitude; any two of which parts being given, the other may be found by the above analogies.

Case I.

Given the difference of longitude between two places, both on the same parallel of latitude, to find their distance.

Example.

A ship in latitude 52° N. and longitude 10° W. sailed due E. till she arrived in longitude 1° 53′ W.; required her distance run.

To find the difference of longitude.

Longitude left - - -	10°	0′W.	
Longitude in - - -	1	53 W.	
Difference of longitude	8	7 W.	= 487 m.

By Inspection.

In solving the several cases of Parallel Sailing by Inspection; if the *complement* of the latitude be taken as a course, in Table 2, the difference of longitude will stand in a distance column, and the distance run in a *departure* column; but if the latitude be found as a course, the difference of longitude will stand in a distance column, and the distance run in a *latitude* column. We shall adopt the former method.

	90°	0′
Latitude - - - - -	52	0
Co-latitude - - - -	38	0

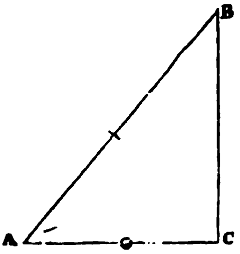
$$\left.\begin{array}{l}\text{Co-latitude } 38^\circ\ 0'\\ \text{Diff. long. } 487 \div 2 = 243{\cdot}5\end{array}\right\}\begin{array}{c}\text{by}\\ \text{Table 2}\end{array}\Big\}\ \text{Dist. or dep. } 149{\cdot}6 + 150{\cdot}2 = 299{\cdot}8$$

By Calculation.

As rad.	0·00000
: diff. long. 487m.	2·68753
:: cos. lat. 52°...........	9·78934
: dist. or dep. 299·8m. ..	2·47687

By Construction.

Draw AC indefinite,
make ∠ BAC = 52° the latitude,
draw AB = 487 difference of longitude,
from B draw the perp. BC, cutting AC in C,
then will
AC = 299·8m. the distance or departure.



Case II.

Given the distance between two places, both on the same parallel of latitude, to find the difference of longitude between them.

Example.

A ship from a port in latitude 25° 40′N. and longitude 12° 30′E. sailed due W. 210m.; required the longitude come to.

By Inspection.

90°—25° 40 = 64 20′ the co. lat.

$$\left.\begin{array}{l}\text{Co. lat. } 64^\circ\ 20'\\ \text{Distance, } 210\text{ m.}\end{array}\right\}\begin{array}{c}\text{by}\\ \text{Table 2.}\end{array}\left\{\begin{array}{l}\text{Taken between } 64^\circ \text{ and } 65^\circ\\ \text{Difference of longitude, } 233\text{ m.}\end{array}\right.$$

By Calculation.

To find the diff. long.

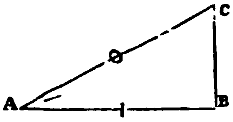
As cos. lat 25°40′ co ar. .	0·04512
: distance 210 m.........	2·32222
:: rad.................	10·00000
: diff. long. 233m........	2·36734

To find the longitude in.

longitude left	12°	30′	E.
diff. of long. 233 m .... =	3	53	W.
longitude in...........	8	37	E.

By Construction.

Draw AB, distance or departure = 210m.
make ∠ A = 25° 40′ the latitude,
draw AC indefinite,
on B erect the perp. BC, cutting AC in C,
then will
AC = 233 m.



CASE III.

Given the difference of longitude, and the distance between two places in the same parallel of latitude, to find the latitude of that parallel.

Example. A ship sailed due W. 312m. and found, by observation, she had changed her longitude 563m.; required the parallel of latitude.

By Inspection,

Diff. long. 563 ÷ 2 = 281·5 } by Table 2, { Co. lat. 34°, consequently the
Dist. or dep. 312 ÷ 2 = 156 } by Table 2, { latitude 56°

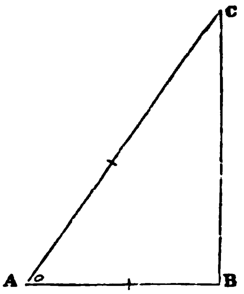
By Calculation.

To find the parallel of latitude sailed on,

As difference of longitude, 563m. co. ar. - - -	7·24949
: rad. - - - - - - - - - - - - - - -	10·00000
:: distance, 312 m. - - - - - - - - - -	2·49416
: cos. lat. 56° 21′ - - - - - - - - - -	9·74365

By Construction.

Draw AB, distance or departure = 312,
on B erect the perp. BC indefinite,
with diff. long. 563, in the compasses, and
centre A, cut the line BC, in C,
draw AC,
then will
∠ CAB = 56° 21′ the latitude required.



Examples for Exercise.

1. It is required to find the number of miles contained in a degree of longitude in any parallel of latitude.

The answer to this example is contained in the following Table.

This Table shews how many Miles answer to a degree of Longitude, at every degree of Latitude.

D.L.	*Miles.*	*D.L.*	*Miles.*	*D.L.*	*Miles.*	*D.L.*	*Miles.*	*D.L.*	*Miles.*
1	59 99	19	56·73	37	47·92	55	34·41	73	17·54
2	59.96	20	56·38	38	47·28	56	33·55	74	16·53
3	59·92	21	56·01	39	46·62	57	32·68	75	15·52
4	59·86	22	55·63	40	45·95	58	31·79	76	14·51
5	59·77	23	55·23	41	45·28	59	30·90	77	13·50
6	59·67	24	54·81	42	44·59	60	30·00	78	12·48
7	59·56	25	54·38	43	43.88	61	29·09	79	11·45
8	59·42	26	53.93	44	43·16	62	28·17	80	10·42
9	59·26	27	53·46	45	42.43	63	27·24	81	9·38
10	59·08	28	52·97	46	41·68	64	26·30	82	8·35
11	58·89	29	52.47	47	40·92	65	25·36	83	7·32
12	58·68	30	51·96	48	40·15	66	24·41	84	6·28
13	58·46	31	51·43	49	39·36	67	23·45	85	5·23
14	58·22	32	50·88	50	38·57	68	22·48	86	4·18
15	57·95	33	50·32	51	37·76	69	21·50	87	3·14
16	57·67	34	49·74	52	36·94	70	20·52	88	2·09
17	57·37	35	49·15	53	36·11	71	19.54	89	1·05
18	57·06	36	48·54	54	35·26	72	18·55	90	0·00

2. A ship in latitude 39° 58′ N. longitude 30° 10′ W. sails due west till she arrives in longitude 34° 5′ W; required her distance run.

Answer, 180·1 m.

3. A ship from a port in latitude 33° 30′ N. longitude 22° 18′ W. sailed due west 240 m.; required her longitude in.

Answer.—27° 6′ W.

4. A ship from a port in latitude 56°N. sailed due north 220 m. then due west 220m. and lastly due south 220m.; required her distance from the port left.

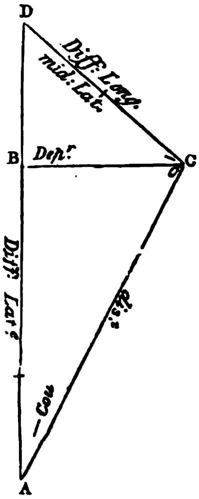
Answer.—243·6 m.

MIDDLE LATITUDE SAILING.

As parallel sailing shows the method of converting departure into difference of longitude, and the difference of longitude into departure, when the ship's course is parallel to the equator; so Middle Latitude Sailing is the method of reciprocating the same elements, where she sails in an oblique rhumb; that is, when she not only makes departure, but difference of latitude also; and since Middle Latitude Sailing is compounded of Plane and Parallel Sailing, we shall endeavour to explain the principles of the first, by very briefly comparing the results deduced from each of the other sailings, separately considered, with their combined effects in determining the relation between the ship's change of place, and her difference of longitude, in the sailing now under consideration.

It has been shown, that by Plane Sailing the course, distance, difference of latitude, and departure, may be accurately determined; and it has also been seen, that by Parallel Sailing the distance sailed on a parallel, the latitude of the parallel, and the corresponding difference of longitude, may be deduced from each other.

Now in Middle Latitude Sailing, the departure being computed by Plane Sailing, and then considered as a meridional distance in the middle parallel, between the latitude sailed from, and that arrived at, the difference of longitude is thence computed as in parallel Sailing.



The annexed figure affords a general illustration of the principles here laid down, and on which the solutions of the several cases in Middle Latitude Sailing depend.

Let the triangle ABC, be a figure in Plane Sailing, in which AC represents the distance, AB, the difference of latitude, BC the departure, and the angle A, the course; also,

Let DBC be a figure in Parallel Sailing, in which DC represents the difference of longitude, BC the meridional distance, and the angle C, the middle latitude. Hence the geometrical construction of a case in Middle Latitude Sailing, comprehends two connected right-angled plane triangles, in which the departure, or meridional distance, (BC) is a side common to both.

Now in any case whatever of Middle Latitude Sailing, it will always happen, that at least two terms in one of these triangles, and one in the other are given, to find the terms required; which required terms, being found by the analogies for right-angled plane Trigonometry, for that triangle which has two terms given, the unknown parts in the other triangle may be readily determined.

This method of deducing the difference of longitude, though not quite accurate, on account of the departure not being strictly equal to the meridional distance in the middle parallel, is, nevertheless, sufficiently so for a single day's run, especially in low latitudes, or when the ship's course is not more than two or three points from a parallel; but in high latitudes, or when the ship's course is nearer to the meridian than to the parallel, Mercator's Sailing should always be preferred.

In computing the difference of longitude by middle latitude, when great accuracy is required, this latitude must be corrected by the following Table, which is to be entered with the *difference* of the two latitudes at the top, and the *Middle Latitude* at the side, under the former, and opposite to the latter, is the correction in minutes, to be *added* to the middle latitude, to obtain the correct middle latitude. In the following Examples, however, this correction is not introduced; its effects on the difference of longitude, as deduced from the middle latitude, being, in general, too insignificant to be worth notice.

TABLE,

Containing the correction in minutes to be added to the Middle Latitude, to obtain the corrected Middle Latitude.

Mid. Lat,	Difference of Latitude.															Mid. Lat.
	1°	2°	3°	4°	5°	6°	7°	8°	9°	10°	12°	14°	16°	18°	20°	
°	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	°
15	0	1	2	3	5	7	9	12	15	18	26	36	47	59	72	15
18	0	1	1	3	4	6	8	10	13	16	23	32	41	52	64	18
21	0	1	1	2	4	5	7	9	12	15	21	29	37	47	68	21
24	0	1	1	2	3	5	7	9	11	14	20	27	35	44	54	24
30	0	1	1	2	3	5	6	8	10	13	18	25	32	41	59	30
35	0	1	1	2	3	4	6	8	10	12	18	24	32	40	49	35
40	0	1	1	2	3	5	6	8	10	13	18	25	32	41	50	40
45	0	1	1	2	3	5	6	8	11	13	19	26	34	43	53	45
50	0	1	1	2	4	5	7	9	11	14	20	28	36	56	57	50
55	0	1	1	3	4	6	8	10	13	16	22	31	40	51	63	55
58	0	1	2	3	4	6	8	11	14	17	24	33	43	55	68	58
60	0	1	2	3	4	6	9	11	14	18	26	35	46	58	72	60
62	0	1	2	3	5	7	9	12	15	19	27	37	49	62	77	62
64	0	1	2	3	5	7	10	13	16	20	29	40	52	67	83	64
66	0	1	2	4	5	8	11	14	18	22	32	43	57	72	90	66
68	0	1	2	4	6	8	12	15	19	24	34	47	62	79	99	68
70	0	1	2	4	6	9	13	16	21	36	38	52	68	88	110	70
72	0	1	3	5	7	10	14	18	23	29	42	58	76	98	124	72

Note.—The middle latitude is found by taking half the *sum* of the two latitudes, when they are both of the same name, or half their *difference* when they are of contrary names.

CASE 1.

Given the latitudes and longitudes of two places, to find the course and distance between them.

Example. A ship from latitude 49° 58′ N. and longitude 5° 11′ W. is bound to a port in latitude 33° 3′N. and longitude 16° 31′W.; required her course and distance.

Lat. left ·	49° 58′N. - -	49° 58′		Long. left - -	5° 11′W.
Lat. bound to	33 3 N. - -	33 3		Long. bound to -	16 31 W.
Diff. of lat.	16 55	Sum 2) 83 1		Diff. long. - -	11 20
	60				60
		Mid. lat. 41 30			
In miles -	1015	90		In miles -	680
	Co. mid. lat. -	48 30			

By Inspection.

The rule for Inspection given in Parallel Sailing, equally applies to this Sailing, merely observing to read *Middle Latitude*, and *Co-Mid. Lat.* for *Latitude*, and *Co-Latitude*.

Co-mid· lat. - 48° 30′ } by Table 2. { Taken between 48° and 49°
Diff.long. 680÷5 = 136m } { Dep. 101·8 × 5 = 509·0m.

Diff.lat 1015÷5 = 203m. } by Table 2. { Cou, S.27°W. or S.S.W.¼W. nearly
Dep. 509÷5 = 101·8m. } { Distance 227 × 5 = 1135m.

By Calculation.

To find the departure.

As rad. - - - - - -	0·00000
: diff. long. 680 m. - -	2·83251
:: cos. mid. lat. 48° 30′	9·87446
: dep. 509·3m. - - -	2·70697

To find the course.*

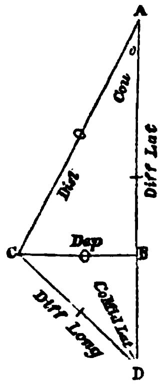
As diff. lat. co. ar. - - -	6·99353
: rad. - - - - - -	10·00000
:: dep. 509·3 m. - - -	2·70697
: tang. cou. 26° 39′ - -	9·70050

To find the distance.

As rad. - - - - - - -	0·00000
: diff. lat. 1015m. - -	3·00647
:: sec. cou. 26° 39′ - -	10·04878
: dist. 1136m. - - -	3·05525

By Construction.

Draw AD indefinite, representing the meridian left,
make ∠ ADC = 48° 30′ the co. mid. lat.
draw DC = 680, the difference of longitude,
from C draw BC, perp. to AD,
make BA = 1015, the difference of latitude,
draw the line AC,
then will
BC, the departure = 509·3m.
∠ BAC = 26° 39′ the ∠ of course, and
AC, the distance = 1135m.



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* The Course may be found without the Departure, by the following proportion,
Diff. lat : diff. long. :: cos. mid. lat. : tang cou.

CASE II.

Given the latitude and longitude left, the course steered, and distance run, to find the latitude and longitude.

Example. A ship from lat. 42° 52′ N longitude 9° 17′W. sailed S.W.bS. 290 miles; required the latitude and longitude come to.

By Inspection.

Course S.W.bS.=3 pts. Distance 290 m.	by Table 1.	Diff. of lat. 241·1 m. Departure 161·1

To find the latitude in, &c.

Latitude left - - - - - - - - -	42° 52′N.
Diff. of lat. 241·1m. - - - - =	4 1 S.
Lat. in - - - - - -	38 51 N.
Sum 2)	81 43
Mid. lat. - - - - -	40 51
	90
Co. mid. lat. - - -	49 9

Co. mid. lat. 49° 9′ Departure 161·1m.	by Table 2.	Difference of longitude 213m.

By Calculation.

To find the diff. lat.

As rad.	0·00000
: dist. 290m...........	2·46240
:: cos. cou. 3 pts.	9·91985
: diff. lat. 241·1m.	2·38225

To find the departure.

As rad.	0·00000
: dist. 290m...........	2·46240
:: sin. cou. 3 pts........	9·74474
: dep. 161·1m.	2·20714

To find the diff. long.*

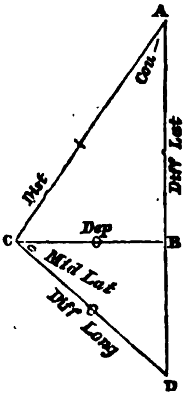
As cos. mid. lat. 40° 51′ co.ar.	0·12123
: departure 161·1m. - - -	2·20710
:: rad. - - - - - - - -	10·00000
: diff. long. 213m. - - -	2·32833

To find the long. in.

Long. left - - - -	9° 17′W.
Diff. long. 213m. - -	3 33 W.
Long. in - - - -	12 50 W.

By Construction.

Draw the meridian, AD, indefinite,
make the ∠ DAC=the course, 3 pts.
draw AC, the distance=290m.
draw CB, perp. to AD,
then will
the departure, CB=161·1m.; and
difference of latitude, AB=241·1m.
Hence,
The latitude in is 38° 51′N. and
the middle latitude is 40° 51′
Now,
make ∠ BCD=40° 51′ the middle latitude, and
draw CD,
then will
CD=213m. the difference of longitude.



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[*] The difference of longitude may also be found, without the departure, by the following proportion, Cos. mid. lat. : diff. lat. :: tang. cou. : diff. long.

CASE III.

Given both latitudes and departure, to find the course, distance, and difference of longitude.

Example. A ship from latitude 34° 55′S. and longitude 20° 18′E. sailed on a direct course, between the S. and E. till she was found by observation to be in latitude 40° 47′S. and to have made 436 miles of easting; required the course steered, distance run, and the longitude at which the ship had arrived.

To find the latitude in.

Latitude left - - -	34° 55′S.	- - - - - - - - -	34° 55.S′
Latitude in - - - -	40 47 S.	- - - - - - - - -	40 47 S.
Difference of latitude. -	5 52	Sum 2)	75 42
	60	Middle latitude -	37 51
In miles -	352		90
		Co. mid. lat. - -	52 9

By Inspection.

Diff. lat. 352÷2=176m. } by Table 2 { Cou. S.51E. or S.E.½E.nearly.
Dep. 436÷2=218m } { Dist. 280 × 2=560m

Co. mid. lat. 52° 9′ } by Table 2, } Diff. long. 277 × 2*=554m
Departure 436÷2=218 m }

By Calculation.

To find the course.

As diff. lat. 352m. co.ar....	7·45346
: rad..	10·00000
:: dep. 436m.	2·63949
: tang. cou. 51° 5′. ...	10·09295

To find the distance.

As rad..................	0·00000
: diff. lat 352m.	2·54654
:: sec. cou. 51° 5′	10·20191
: dist. 560·3..........	2·74845

To find the diff. long.

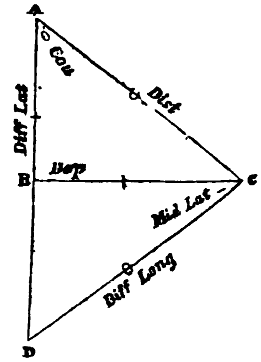
As cos. mid. lat. 37°51′ co. ar.	0·10258
: dep. 436m.	2·63949
:: rad.	10·00000
: diff. long. 552·2m	2·74207

To find the long. in.

Long. left...........	20° 18′E.
Diff long. 552m.....	= 9 12 E.
Long. in.	29 30 E.

By Construction.

Draw the meridian line AD indefinite,
from A to B lay off diff. lat.=352m.
on B, erect the perp. BC=436, the dep. and join AC,
make the ∠ BCD=37° 51′ the mid. lat.
draw CD,
then will,
∠ CBA, the ∠ of course=51° 5′
the distance, AC=560·3m; and
the diff. of long. DC=552·2m.



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* By taking a proportion we might produce a result something nearer to that obtained by calculation; the difference is, however, too small to be of any importance, and being on the safe side, giving the reckoning a-head of the ship, is the less worthy of notice.

Case IV.

Given both latitudes and the course, to find the departure, distance and longitude in.

Example. A ship from lat. 37° 25′S. and long. 10° 44′W. sailed N.E.b.N½E. to lat. 33° 10′S.; required the departure, distance, and longitude in.

To find the difference of latitude, &c.

Latitude left - - -	37° 25′S.	- - - - - - -	37° 25′S.
Latitude in - - -	33 10 S.	- - - - - - -	33 10 S.
Diff. lat. - - - -	4 15	Sum 2)	70 35
	60		
In miles - -	255	Mid. lat. -	35 17
			90
		Co. mid. lat. - - -	54 43

By Inspection.

Cou.N.E.b N.½E.=3½ pts. } by Table 1. { Dist.165 × 2=330m.
Diff. lat.255÷2=127·5m. } { Dep. 104·7 × 2=209·4m.

Co. mid. lat. 54° 43′ } by Table 2. { Diff. long. 256m.
Departure 209·4m. }

By Calculation.

To find the departure.

As cos. cou. 3½ pts. co. ar. ..	0·11181
: diff. lat. 255m.	2·40654
:: sin. cou. 3½ pts	9·80236
: dep. 209·3m.	2·32071

To find the distance

As cos. cou. 3½ pts. co.ar. ...	0·11181
: diff. lat. 255m.	2·40654
:: rad.	10·00000
: dist. 329·9m.	2·51835

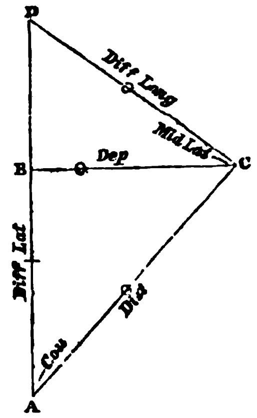
To find the diff. long.

As cos. mid. lat. 35° 17′ co,ar.	0·08815
: dep. 209·3m.	2·32077
:: rad.	10·00000
: diff. long. 256·4m	2·40892

To find the longitude in

Long. left - - -	10° 44′W.
Diff. long. 256·4m =	4 16 E.
Long. in , - -	6 28 W.

By Construction.



Draw the meridian line AD, indefinite,
from A to B, lay off difference of latitude 255m.
on B erect the perp. BC, indefinite,
make ∠A= ∠of course, 3½ points, and draw AC, cutting BC in C,
make ∠BCD=35° 17′ the mid. lat.
draw the line CD,
then will
BC, the departure=209·3m.
AC, the distance=329·9m.; and
DC, the difference of longitude=256m.

CASE V.

Given both latitudes and the distance, to find the course, and difference of longitude.

Example. A ship from latitude 49° 10′ N. longitude 53° 30′ W. sailed 369 m. upon a direct course in the N.E. quarter, to latitude 52° 47′ N. required her course, departure, and longitude in.

Latitude left - - -	49° 10′N.		- - - - - - - - -	49° 10′N.
Latitude in - -	52 47 N.		- - - - - - - - -	52 47 N.
Diff. lat. - - - -	3 37		Sum 2)	101 57
	60			
In miles -	217		Mid. lat.	50 58
				90 0
			Co. mid. lat. -	39 2

By Inspection.

$$\left.\begin{array}{l}\text{Dist. } 369\div 3 = 123\text{m.}\\ \text{Diff. Lat. } 217\div 3 = 72{\cdot}3\text{ m.}\end{array}\right\}\begin{array}{c}\text{by}\\ \text{Table 1}\end{array}\left\{\begin{array}{l}\text{Cou. N.}54^\circ\text{E. or N.E}\cdot\tfrac{3}{4}\text{E. nearly}\\ \text{Dep. } 99{\cdot}5\times 3 = 298{\cdot}5\text{m.}\end{array}\right.$$

$$\left.\begin{array}{l}\text{Co. Mid. Lat. } 39^\circ\ 2'\\ \text{Dep. } 298{\cdot}5\div 2 = 149{\cdot}2\text{m.}\end{array}\right\}\begin{array}{c}\text{by}\\ \text{Table 2}\end{array}\left.\right\}\text{Diff. Long. } 237\times 2 = 474\text{m.}$$

By Calculation.

To find the course.

As dist. 369 co.ar.	7·43297
: rad.	10·00000
:: diff. lat. 217 m.	2·33646
: cos. cou. 53° 59′	9·76943

To find the departure.

As rad.	0·00000
: dist. 369m.	2·56703
:: sin. cou. 53° 59′	9·90787
: dep. 298·5m.	2·47490

To find the diff of long

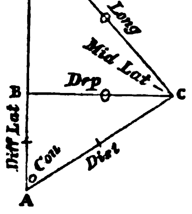
As cos. mid. lat. 50°58′ co. ar.	0·20082
: dep. 298·5 m.	2·47494
:: rad.	10·00000
: diff. long. 474 m.	2·67576

To find the longitude

Longitude left - - -	53° 30′W.
Diff. of long. 474m .	7 54 E.
Longitude in - -	45 36 W.

By Calculation.

Draw the meridian line AD indefinite
from A to B lay off 217 = difference of latitude
on B, erect the perp. BC,
with the dist. 369 in the compasses, and one foot in A,
let the other foot fall at C, in the line BC,
draw the line AC
make the ∠BCD 50° 58′ = the middle latitude
draw CD,
then will
the ∠BAC, the ∠ of course = 53° 59′
departure, BC = 298·5 m. and
difference of longitude, CD = 474 m.



CASE VI.

Given the latitude from, the course steered, and departure made good, to find the distance, difference of latitude, and difference of longitude,

Example. A ship from lat. 46° 18′N. long. 8° 47′W. sailed N. W. ½W. untill she had made 184 miles of westing; required her distance run, and the latitude and longitude in.

By Inspection.

Course N.W.½W.=4½ Pts. } by Table 1. { Distance 238 m.
Departure - - 184 m. } by Table 1. { Diff. lat. 151 m.

To find the latitude in &c.

Latitude left - - - - -	46°	18′N.
Difference of latitude 151m. -	2	31 N.
Latitude in	48	49 N.
Sum 2)	95	7
Mid. lat.	47	33
	90	
Co. mid. lat.	42	27

Co. mid. lat. - 42° 27′ } by Table 2. { Diff. long, 272·5 m
Departure - 184 m. }

By Calculation.

To find the diff. lat.

As sin. cou. 4½ pts. co. ar. .	0·11181
: dep. 184m............	2·26482
:: cos. cou. 4½ pts.......	9·80236
: diff. lat. 151 m........	2·17899

To find the distance.

As sin. cou. 4½ pts. co. ar. .	0·11181
: dep. 184 m..........	2·26482
:: rad.	0·00000
: dist. 238m............	2·37663

To find the diff. long.

As cos. mid. lat. 47°33′ co. ar. .	0·17073
: dep. 184m.	2·26482
:: rad.	10·00000
: diff. long. 272·6m.....	2·43555

To find the long. in.

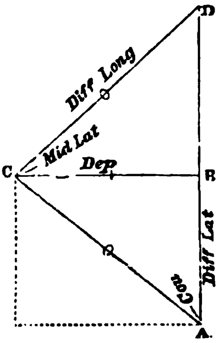
Longitude left	8°	47′W.
Diff. long. 273m.	4	33 W.
Longitude in.	13	20 W.

By Construction.

Draw the meridian line AD, indefinite perp. to AD, at the point A, draw AE=the dep. 184m. draw EC indefinite, parallel to AD, make the ∠ BAC=4½ pts. the course, and draw AC cutting EC in C, from C, draw BC parallel to AB make the ∠ BCD=42° 27′ the co. mid. lat. draw CD,

then will

AB, the difference of latitude=151m.
AC, the distance=238m.
CD, the difference of longitude=272·6m,



Case VII.

Given the latitude and longitude left, distance run, and departure made good, to find the course steered, and latitude and longitude in.

Example. A ship from the Bell Rock, in latitude 56° 26′N. and longitude, 2° 23′W. sailed 180m. on a direct course, between the N. and E. till her departure was 86m.; required her true course, and the latitude and longitude arrived at.

By Inspection.

Dist. 180 m. } by { Course, N. 28½E. or N.N.E.½ E. nearly,
Dep. 86 m. } Table 2. { Diff. lat. $\overline{158{\cdot}9+157{\cdot}4}\div 2=158{\cdot}1$ m.

To find the latitude in.

Latitude left - - - - - -	56° 26′N.
Diff. lat. 158·1m. - - - -	= 2 38 N.
Latitude in - - - - - - -	59 4 N.
Sum	2) 115 0
Mid. lat. - -	57 45
	90
Co. mid. lat. - -	32 15

Co. mid. lat. 32° 15′ } by { Taken between 32° and 33° by a
Departure 86 m } Table 2. { proportion, gives diff.long.161 m.

By Calculation.

To find the course.

As dist. 180 co.ar. - - -	7·74473
: rad. - - - - - - -	10·00000
:: dep. 86m. - - - -	1·93450
: sin. cou. 28° 32′ - -	9·67923

To find the diff. lat.

As rad. - - - - - - -	0·00000
: dist. 180m. - - -	2·25527
:: cos. 28° 32′ - - - -	9·94376
: diff. lat. 158·1 - - -	2·19903

To find the diff. long.

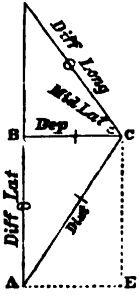
As cos. mid lat. 57°45′ co,ar. -	0·27277
: departure 86m. - - - -	1·93450
:: rad. - - - - - - - - -	10·00000
: diff. long. 161·2m. - - -	2·20727

To find the long. in.

Long. left - - -	2° 23′W.
Diff. long. 161·2m.	= 2 41 E.
Long. in. - - -	0 18 E.

By Construction.

Draw the meridian line AD, indefinite, on A erect the perp. AE = 86m. the departure, on E draw EC, parallel to AD, indefinite, with the distance 180 in the compasses, and centre A, cut CE in C; join AC, draw BC parallel to AE; then will ∠ BAC, the ∠ of course, = 28° 32′; and AB, the difference of latitude, = 158·1m.; hence, the latitude in will be 59° 4′, and the middle latitude, 57° 45′; make the ∠ BCD = 59° 4′, draw DC, cutting AD in D: then will DC = 161·2 m. the difference of longitude.



Examples for Exercise.

1. A ship from latitude, 53° 18′N. longitude, 0° 55′ E. is bound to a port in latitude, 57° 58′N. and longitude, 7° 3′E.; required her course and distance.

Answer.—Course, N. 36° 34′E. or N.E.b.N:¼E, nearly;
distance 348·6m.

2. A ship from latitude, 54° 28′N. longitude, 13° 18′W. sailed S.W.b.W· 300 miles; required the latitude and longitude in.

Answer,—Latitude in, 51° 41′N. longitude, 20° 13′W.

3. A ship from latitude, 33° 45′S. longitude 78° 37′W. sails on a direct course between the S. and E. to latitude 36° 54′S. and 160 miles to the eastward; required her true course, distance, and longitude arrived in.

Answer,—Course, S. 40° 15′E. or S.E.b.S.½E. nearly;
distance, 247·6m. longitude in, 75° 21′W.

4. A ship from latitude 14° 46′N. and longitude 24° 46′W. sailed S.E.b.S. until she arrived in latitude 10° 30′N.; required her departure made good, distance run, and longitude in.

Answer,—Departure, 171·1m. distance, 307·9m. longitude in, 21° 51′W.

5. A ship from latitude 37°N, and longitude 10° 25′W. sailed on a direct course 300 miles, between the N. and W. until she arrived in latitude 41°N.; required her course, departure, and longitude in,

Answer,—Course, N. 36° 52′W. or N.W.b.N.¼W. nearly;
departure, 180m. longitude in, 14° 17′W.

6. A ship from latitude 50° 10′S. longitude, 10° 13′E. sails E.S.E. until her departure is 957m.; required her distance run, and latitude and longitude in.

Answer,—Distance, 1036m. latitude in, 56° 46′S. longitude in, 37° 1′E.

7. A ship from latitude 49° 30′N. and longitude 14° 40′W sails between the S. and E. 645 miles, until her departure is 500 miles; required the course steered, and the latitude and longitude in.

Answer,—Course S. 50° 50′E. or S.E.½E. nearly;
latitude in, 42° 43′N. longitude, 2° 39′W.

MERCATOR'S SAILING.

Mercator's, like Middle Latitude Sailing, is designed to obviate the difficulties which result from the spherical figure of the earth, in determining at any time the place of a ship at sea ; or, the relation between a ship's change of place, and her difference of longitude when she sails on an oblique rhumb. The imperfection of Middle Latitude Sailing has been already pointed out.

Mercator's Sailing, is derived from Wright's, commonly called Mercator's Chart, which may be produced by development, in the following manner. Conceive a globe or sphere with the usual delineations on its surface, to be circumscribed by a hollow cylinder, whose axis coincides with that of the globe, and let us now suppose that this globe is expanded in its dimensions north and south of the equator, just as a bladder in the same situation would swell in those directions by continual inflation : the parts always stretching uniformly, the meridians will be increased in length, in the same proportion as the parallels, till finally, all parts of the expanding globular surface will be transferred to the concave surface of the cylinder, very nearly in the same manner as if they had been referred to it by lines drawn from the centre of the globe through every point of its surface. The meridians will become straight lines, and the parallels circles on the surface of the cylinder; the former in the direction of its length, and the latter parallel to its base.

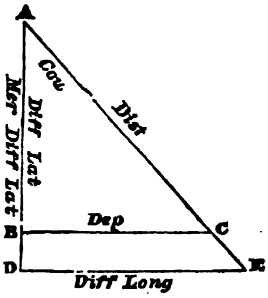
If now the cylinder be unrolled, and spread into a plane, the surface thus produced will be a Mercator's Chart, which, like a map of the stereographic projection, gives a true representation as to *form*, of every particular minute part, but varies greatly as to *scale* in different regions; the polar portions, especially, are extravagantly enlarged, and it is utterly impossible to comprise within finite limits the whole map, even of a single hemisphere.

From what has now been said, it will be easily seen, that in a Mercator's Chart the distance between any two meridians is made equal to their difference of longitude, the degrees of longitude are, therefore, every where equal to one another; and, consequently, the parallels of latitude are enlarged in the ratio of the cosine of the latitude to the radius, while the rhumb line, or track the ship describes, is represented by a straight line. Now in order that the angle which the rhumb line makes with the several meridians on the chart, may correspond with the same angle on the globe, it will be necessary to increase the meridian in the same ratio by which the parallels of latitude are increased; viz. as the cosine of the latitude is to the radius, or, which is the same thing, as the radius is to the secant of the latitude. Hence, the degrees of the meridians on a Mercator's chart increase toward the poles, as the secant of the latitude increases; likewise, all the parallels of latitude, and every part of them, are larger than they are on the globe, in the ratio of the radius to the secant of the latitude. Hence also, though the latitudes, longitudes and bearings of places, are truly represented on a Mercator's chart, the distances are distorted in various proportions.

The difference of latitude between two places increased in the above-mentioned proportion, is called the *meridional* difference of latitude, to distinguish it from the actual distance of their parallels, which is called the *proper* difference of latitude, or simply the *difference of latitude.*

The annexed figure will tend to illustrate the application of the foregoing principles to the solution of the several cases of Mercator's Sailing.

Let ABC be a triangle in Plane Sailing, in which A represents the course, AC, the distance, AB, the difference of latitude, and BC the departure. Let AB be produced to D, making AD equal the meridional difference of latitude; also let DE be drawn parallel to BC, and AC produced to E, then will ADE be a figure in Mercator's Sailing, in which DE represents the difference of longitude. Now the angle A being common to the two triangles ABC, ADE, and the sides BC and DE parallel, they are similar triangles; therefore the sides containing the equal angles of the one, are proportional to the sides containing the equal angles of the other, Hence all the analogies for the solution of the different cases in Mercator's Sailing, may be readily deduced agreeably to the principles of right-angled Plane Trigonometry.



The length of the expanded meridian, or the meridional difference of latitude, between any two parallels, is found by means of Table 6, by the same rules as those already given for finding the difference of latitude viz. if the two given latitudes be of the same name, the *difference* of the corresponding meridional parts will be the meridional difference of latitude; but if the latitudes be of contrary names, the *sum* of those parts will be the meridional difference of latitude.

Case I.

Given the latitudes and longitudes of two places, to find the course and distance between them.

Example. *Required the course and distance from a port in latitude 49° 58′N. and longitude 5° 11′W. to another port in latitude 33° 3′N. and longitude 16° 31′W.

Lat. left - - -	49° 58′N.	mer. pts.	3471	long. left - - -	5° 11′W.
Lat. bound to -	33 3 N.	mer. pts	2103	long. bound to	- 16 31 W.
Diff. of lat. - -	16 55	mer.diff.lat.	1368	diff. long. - - -	- 11 20
	60				60
In miles -	1015			In miles -	680

By Inspection.

$$\left.\begin{array}{l}\text{Mer.diff.lat. } 1368\div10=136\cdot8\text{m.}\\ \text{Diff. long. } 680\div10=68\text{m.}\end{array}\right\}\begin{array}{c}\text{by}\\ \text{Table 2}\end{array}\left\{\begin{array}{l}\text{Cou. S. } 26\tfrac{1}{2}{}^{\circ}\text{W, or S.S.W}\\ \quad\tfrac{1}{4}\text{ W. nearly.}\end{array}\right.$$

$$\left.\begin{array}{l}\text{Course - - - - } 26\tfrac{1}{2}{}^{\circ}\\ \text{Diff. lat. } 1015\div5=203\text{ m.}\end{array}\right\}\begin{array}{c}\text{by}\\ \text{Table 2.}\end{array}\left.\right\}\text{ Distance } 227\times5=1135\text{m.}$$

By Calculation.

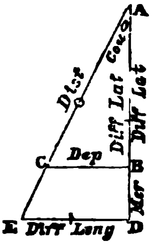
To find the course.

As mer. diff. lat. 1368 co.ar.	6·86391
: rad. - - - - - - -	10·000000
:: diff. long. 680m. - -	2·83251
: tang. cou. 26°26′ - -	9·69642

To find the distance.

As rad. - - - - - - -	0·00000
: diff. lat. 1015m - - -	3·00647
:: sec cou. 26° 26′ - -	10·04796
: dist. 1134m. - - - -	3·05443

By Construction.



Draw the line AD = 1368, the mer. diff. lat.
on D, erect the perp. DE = 680, the diff. long.
draw the line AE,
from A to B lay off 1015, the diff. lat.
on B, draw BC, parallel to DE,
then will
∠ BAD, the ∠ of course, = 26½°; and
AC, the distance = 1134 m.

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* In order that a comparison may be formed of the results obtained by Middle Latitude and Mercator's Sailings, the Examples in the latter are the same as those already given in the former; the same may be observed with respect to the Examples for Exercise.

CASE II.

Given the latitude and longitude left, the course steered, and distance run, to find the latitude and longitude.

Example. A ship from latitude 42° 52′N. longitude 9° 17′W. sailed S.W.b.S. 290 miles; required the latitude and longitude in.

By Inspection,

Course S.W.b.S. = 3 pts. Distance 290m.	by Table 1.	Diff. of lat. 241·1 m.

To find the latitude in, &c.

Latitude left - - -	42° 52′N.	mer. pts.	2852
Diff. lat. 241·1m. -	= 4 1 S.		
Lat. in - - - -	38 51 N.	mer. pts.	2533
		mer. diff. lat. -	319

Course S.W.b. S. = 3 pts. Mer.diff.lat.319 ÷ 2 = 159·5	by Table 1.	Diff.long. 106·7 × 2 = 213·4m.

By Calculation.

To find the diff. lat.

As rad. - - - - - -	0·00000
: dist. 290m - - - -	2·46240
:: cos. cou. 3 pts. - - -	9·91985
: diff. lat. 241·1m - -	2·38225

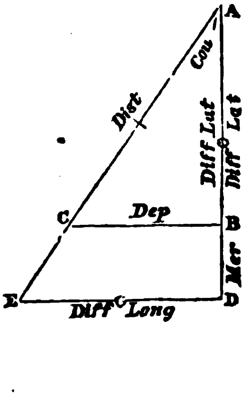
To find the diff. long.

As rad. - - - - - -	0·00000
: mer. diff. lat. 319m. .	2·50379
:: tang. cou. 3 pts. - -	9·82489
: diff. long. 213·1m. - -	2·32868

To find the longitude in.

Longitude left - - -	9° 17′W.
Diff. long. 213·1m. · ·	3 33 W.
Long. in - - -	12 50 W.

By Construction.



Draw the meridian line, AD, indefinite,
make ∠ DAE, the ∠ of course, = 3 pts.
draw AE indefinite,
on AE lay off AC = 290m. the distance,
from C draw CB, perp. to AD; then will
AB = 241·1m. diff. of lat.

Hence, the latitude in is 38° 51′N. and mer. diff. lat. 319.

Make AD = 319, on D draw DE, parallel to BC, then will DE = 213·1 m. the difference of longitude.

Case III.

Given both latitudes and departure, to find the course, distance, and difference of longitude.

Example. A ship from latitude 34° 55′S. and longitude 20° 18′E. sailed on a direct course, between the S. and E. till she was found by observation to be in latitude 40° 47′S. and to have made 436 miles of easting; required the course steered, distance run, and the longitude at which the ship had arrived.

To find the latitude in, &c.

Latitude left - - -	34° 55′S:	mer. pts. -	2238
Latitude in - - -	40 47 S.	mer. pts. -	2684
Difference of latitude	5 52=352m.	mer. diff. lat.	446

By Inspection.

Diff. lat. 352÷2=176m. } by Table 2 { Cou. S.51 E. or S.E.¾E. nearly.
Departure 436÷2=218m. } by Table 2 { Distance . 280×2=560m.

Course - 51° } by Table 2. } Diff. long.137·6×4=550·4m.
mer.dif.lat 446÷4=111·5m } by Table 2. } Diff. long.137·6×4=550·4m.

By Calculation.

To find the course.

As diff. lat. 352m. co. ar.	7·45346
: rad. - - - - - -	10·00000
:: dep. 436m. - - - -	2·63949
: tang. cou. 51° 5′ - -	10·09295

To find the distance.

As rad. - - - - - - -	0·00000
: diff. lat. 352m. - - -	2·54654
:: sec, cou. 51° 5′ - -	10·20191
: dist. 560·3m. - - -	2·74845

To find the diff. of long.*

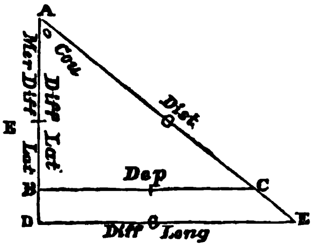
As rad. - - - - - - -	10·00000
: mer. diff. lat. 446 - -	2·64934
:: tang. cou. 51° 5′ - -	10·09292
: diff. long. 552·4m. - -	2·74226

to find the long. in.

Long. left - -	20° 18′E.
Diff. long. 552·4m. =	9 12 E.
Longitude in -	29 30 E.

By Construction.

Draw AD=446, the mer. diff. lat.
on AD lay off AB=352. the diff. lat.
on B, erect the perp. BC=436, the dep.
draw DE indefinite, parallel to BC,
from A through C draw AE, intersecting DE in E
then will
∠ CAB, the ∠ of course,=51° 5′,
AC, the distance=560·3m.; and
DE, the difference of longitude=552·4m.



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* ABC, ADE being similar triangles, the difference of longitude may be found, independent of the course, by the following proportion,

prop. diff. lat. : dep. :: mer. diff. lat. : diff. long.

CASE IV.

Given both latitudes and the course, to find the departure, distance, and longitude in.

Example. A ship from latitude 37° 25′S. and longitude 10° 44′W. sailed N.E. b N. ½ E. to latitude 33° 10′S.; required the departure, distance, and longitude in.

To find the difference of latitude, &c.

Latitude left..........	37° 25′S.	mer. pts	2424
Latitude in...........	33 10 S.	mer. pts..........	2111
Diff. lat.	4 15 = 255m.	mer. diff. lat......	313m.

By Inspection.

Course N.E.bN. ½ E. = 3½pts. } by Table 1. { Dist. 165 × 2 = 330m.
Diff. lat. 255 ÷ 2 = 127·5 } by Table 1. { Dep. 104·7 × 2 = 209·4m.

Cou, N.E.bN. ½E· = 3½pts. } by Table 1. } dif.long. 128·4 × 2 = 256·8m.
Mer.dif.lat. 313 ÷ 2 = 156·5m.

By Calculation.

To find the departure.

As cos. cou 3½pts. co ar. .	0·11181
: diff. lat. 255m........	2·40654
:: sin. cou. 3½pts........	9·80236
: dep. 209·3m.	2·32071

To find the distance.

As cos. cou. 3½ pts co ar...	0·11181
: diff lat. 255m........	2·40654
:: rad.................	10·00000
: dist. 329·9m.	2·51835

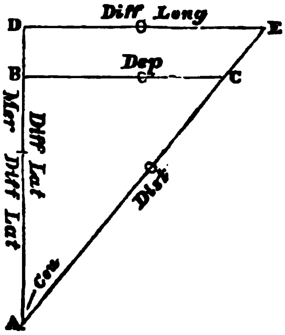
To find the diff. long.

As rad..................	10·00000
: mer. diff. lat. 313m....	2·49554
:: tang. cou 3½pts.......	9·91417
: diff. long. 256·9m......	2·40971

To find the longitude in.

longitude left	10° 44′W.
diff. of long. 256·9 m... =	4 17 E.
longitude in...........	6 27 W.

By Construction.



Draw the line AD = 313, the mer. diff. lat.
on AD lay off diff. lat. = 255m. from A to B,
on D erect the perp. DE, indefinite,
make ∠ DAE the ∠ of course = 3½ points
draw AE, cutting DE in E,
draw BC parallel to DE,
then will
AC, the distance = 329·9m.
BC, the departure = 209·3m.; and
DE, the difference of longitude = 256·9m.

CASE V.

Given both latitudes and the distance, to find the course, and difference of longitude

Example. A ship from latitude 49° 10′N. longitude 53° 30′W. sailed 369m. upon a direct course in the N.E. quarter, to latitude 52° 47′N.; required her course, departure. and longitude in.

To find the difference of latitude, &c.

Latitude left - - -	49° 10′N.	mer. pts.	3397
Latitude in - - -	52 47 N.	mer. pts.	3742
Diff. lat. - - - -	3 37 = 217m.	mer. diff. lat.	345

By Inspection.

Dist. 369 ÷ 3 = 123m. } by {Cou. N. 54° E. or N.E.¾E. nearly
Diff. lat. 217 ÷ 3 = 72·3m. } Table 2. {Dep. 99·5 × 3 = 298·5 m.

Course - - - - 54° } by {Dif. long. 237 + 237·9 = 474·9m.
mer. dif. lat. 345 ÷ 2 = 172·5m } Table2. {(taken between 172·2 & 172·8.)

By Calculation.

To find the course.

As dist. 369 co. ar. - -	7·43297
: rad. - - - - - - -	10·00000
:: diff. lat. 217m. - - -	2·33646
: cos. cou. 53° 59′ - -	9·76943

To find the departure.

As rad. - - - - - - -	0·00000
: dist. 369m. - - - - -	2·56703
:: sin. cou. 53° 59′ - - -	9·90787
: dep. 298·5m. - - -	2·47490

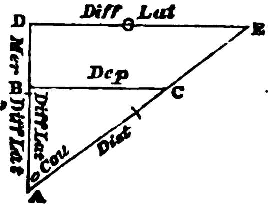
To find the diff. long.

As cos. cou. 53° 59′ co. ar. - -	0·23061
: mer. diff. lat. 345m. - -	2·53782
:: sin cou. 53° 59′ - - - -	9·90787
: diff. 474·5m. - - - - - -	2 67630

To find the long in.

Longiiude left - - - -	53° 30′W
Diff. long. 474·5m. - - - =	7 55 E.
Longitude in - - - - - -	45 35 W.

By Construction.



Draw the line AD = 345, the mer. diff. lat.
on this line lay off AB = 217 the diff. lat.
on B, erect the perp. BC indefinite,
with the dist. 369 in the compasses, and centre A, cut the line BC in C,
through C, draw the line AE, indefinite,
draw DE parallel to BC, meeting ACE in E, then will
the ∠ BAC, the ∠ of course = 53° 59′
BC, the departure = 298·5 m. and
DE, the difference of longitude = 474·5m.

CASE VI.

Given the latitude from, the course steered, and departure made good, to find the distance, difference of latitude, and difference of longitude.

Example. A ship from latitude 46° 18'N. long. 8° 47'W. sailed N.W. ½W. until she had made 184 miles of westing; required her distance run, and the latitude and longitude in.

By Inspection,

Course N.W.½W.=4½ pts. } by Table 1. { Distance, 238m.
Departure - - 184 m. } by Table 1. { Diff. lat. 151m.

To find the latitude in.

Latitude left - - -	46° 18'N.	mer. pts. -	3142
Diff. lat. 151m. -	= 2 31 N.		
Latitude in - - -	48 49 N.	mer. pts. -	3365
		mer. diff. lat.	223

Cou. N.W.½W.=4½ pts. } by Table 1, } Diff. long. 136 × 2=272m.
Mer.dif.lat.223÷2=111·5m. }

By Calculation.

To find the diff. lat.

As sin cou. 4½pts. co-ar....	0·11181
: dep. 184m.	2·26482
:: cos. cou, 4½ pts.......	9·80236
: diff. lat. 151m.	2·17899

To find the distance.

As sin. cou. 4½pts. co-ar. ..	0·11181
: dep. 184m.	2·26482
:: rad.................	10·00000
: dist. 238m.	2·37663

To find the diff. long.

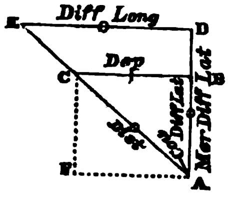
As cos. cou. 4½pts co ar...	0·19764
: mer. diff. lat. 223m.	2·34831
:: sin. cou. 4½ pts.	9·88819
: diff. long. 271·7m	2·43414

To find the long. in.

Long. left.........	8° 47'W
Diff. long. 271·7m. .	4 32 W.
Longitude in......	13 19 W.

By Construction.

Draw the meridian line AD, indefinite,
from A draw AF, perp. to AD=the dep. 184m.
make the ∠A=4½ pts. the course, and
draw AE indefinite,
from F, draw FC parallel to AD, and cutting AE in C
draw CB, parallel to FA,
then will
AC, the distance=238m.; and
AB, the difference of latitude=151m.
Hence, the latitude in is 48° 49'N.; and
the mer. diff. lat. 223;
make AD=223, the mer. diff. lat.
draw DE parallel to BC, meeting AE in E,
then will
DE, the difference of longitude=271·7m:



Case VII.

Given the latitude and longitude left, distance run, and departure made good, to find the course steered, and latitude and longitude in.

Example. A ship from the Bell Rock, in latitude 56° 26′N. and longitude, 2° 23′W. sailed 180m. on a direct course, between the N. and E. till her departure was 86m.; required her true course, and the latitude and longitude arrived at.

By Inspection.

Dist. 180m. } by { Course, N.28½°E. or N.N.E.½E. nearly,
Dep. 86m. } Table 2. { Diff. lat. $\overline{158{\cdot}9+157{\cdot}4}\div2=158{\cdot}1$m.

To find the latitude in, &c.

Latitude left - -	56° 26′N.	mer. pts.	4121
Diff. lat. 158·1m. =	2 38 N.		
Latitude in - -	59 4 N.	mer. pts.	4417
		mer. diff.lat. -	296

Course - - - - 28½° } by } Dif.long.78·9 + 81·9 = 160·8m
Mer. dif. lat. 296÷2 = 148 m. } Table2. }

By Calculation.

To find the course.

As dist. 180 co.ar.	7·74473
: rad.	10·00000
:: dep. 86m.	1·93450
: sin. cou. 28° 32′	9·67923

To find the diff. lat.

As rad.	0·00000
: dist. 180m.	2·25527
:: cos. 28° 32′	9·94376
: diff. lat. 158·1	2·19903

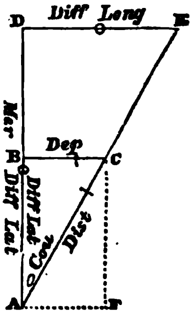
To find the diff. long.

As cos. cou. 28° 32′ co.ar. ...	0·05624
: mer. diff. lat. 296m	2·47129
:: sin. cou. 28° 32′	9·67913
: diff. long. 160·9m.	2·20666

To find the long. in.

Longitude left.	2° 23′W
Diff long. 160·7m. =	2 41 E.
Longitude in.	0 18 E.

By Construction.



Draw the meridian line AD, indefinite,
on A erect the perp. AF = 86m. the departure,
draw FC, parallel to AD, indefinite,
with the dist. 180 in the compasses, and one foot in A
cut FC in C,
join AC, and draw BC parallel to AF,
then will
∠ BAC, the course = 28° 32′; and
AB, the difference of latitude = 158·1m.
Hence, the latitude in is 59° 4′, and
mer. diff. lat. 296,
From AD lay off 296,
through D, draw DE, parallel to BC, indefinite,
produce AC till it meets the line DE in E,
then will
DE = 160·9m. the difference of longitude.

Examples for Exercise.

1. A ship from latitude, 53° 18'N. longitude, 0° 55'E. is bound to a port in latitude, 57° 58'N. and longitude, 7° 3'E.; required her course and distance.

Answer,—Course N. 36° 31'E. or N.E.b.N.¼E. nearly;
distance 348·4m.

2. A ship from latitude, 54° 28'N. longitude, 13° 18'W. sailed S.W.b.W. 300 miles; required the latitude and longitude in.

Answer,—Latitude in, 51° 41'N. longitude, 20° 16'W.

3. A ship from latitude 33°45'S. longitude 78° 37'W. sails on a direct course between the S. and E. to latitude 36° 54'S. and 160 miles to the eastward; required her true course, distance, and longitude arrived in.

Answer,—Course, S. 40° 15'E.; distance, 247·6 m.
longitude in, 75° 21'W,

4. A ship from latitude 14° 46'N. and longitude 24° 46'W. sailed S.E.b.S. until she arrived in latitude 10° 30'N.; required her departure made good, distance run, and longitude in.

Answer,—Departure, 171·1 m. distance, 307·9m.
longitude in, 21° 51'W.

5. A ship from latitude 37°N. and longitude 10° 25'W, sailed on a direct course 300 miles, between the N. and W. until she arrived in latitude 41°N.; required her course, departure, and longitude in.

Answer,—Course, N. 36° 52'W,; departure, 180 m.
longitude in, 14° 17'W.

6. A ship from latitude 50° 10'S. longitude 10° 16'E. sails E.S.E. until her departure is 957m.; required her distance run, and latitude and longitude in.

Answer,—Distance, 1036 m. latitude in, 56° 46'S.
longitude in, 37° 6'E.

7. A ship from latitude 49° 30'N. and longitude 14° 40'W. sails between the S. and E. 645 miles, until her departure from the meridian is 500 miles; required the course steered, and the latitude and longitude in.

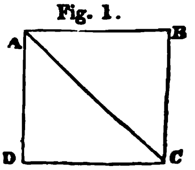
Answer,—Course, 50° 50'E. or S,E.½E. nearly;
latitude in, 42° 43'N. longitude, 2° 38'W.

CURRENT SAILING.

By a current is meant a progressive motion of the water, whereby all bodies floating thereon, are carried forward in the direction to which its stream is impelled. The *setting* of a current is that point of the compass towards which its course is directed, and the *drift* of a current is the rate of its hourly motion: now the determination of a ship's true course and distance, when her own motion is combined with, or affected by that of the current in which she sails, constitutes what is called CURRENT SAILING.

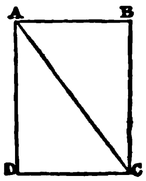
When a ship sails in the direction of a current, the total velocity of her motion will be the sum of her own proper rate of sailing, added to the drift of the current, but her velocity will be expressed by the difference between these two, when she sails in an opposite direction; her absolute motion being a-head, when her proper velocity is greater than that of the drift of the current, but a-stern when it is less. When her course is oblique to the direction of the current, the ship being acted upon at the same time by two forces in different directions, will, by the combination of these forces take an intermediate course, and describe the diagonal of a parallelogram, the two adjacent sides of which represent the tracks she would have described, under the separate influence of the wind and current respectively. Thus, let us suppose a ship at A, Fig. 1. to be acted upon by the wind, in the direction AB, with such a force as would cause it to move from A to B, in the same time that a current acting in the direction AD, would cause it to describe the line AD = AB, the ship being acted upon at the same time, by two forces in different directions, will, by the combination of these forces, take an intermediate course, and describe the diagonal AC, and the two forces being supposed equal, the point C, at which she will have arrived at the expiration of any given interval of time, will be exactly as far from the places B and D to which the wind and current respectively tended to carry it, as the place A, from which she set out.

Fig. 1.



But if, as in Fig. 2, these forces be unequal, then the ship in the same time will describe the line AC, and when at C, will be at the same distance from the more remote place of tendency D, as she was from the nearer B, and at the same distance from the nearer place of tendency B, as she was from the more remote one D, at the time of her setting out from A. Hence the ship's true distance will be the line AC, and her true course will be the angle that line makes with the meridian.

Fig. 2.



The effect of the current on the motion and place of the ship, may be most conveniently determined, by considering the ship to have performed a traverse; the setting and drift of the current being taken as a separate course and distance, as in the following

Example.

Suppose a ship sailed 98 miles N.E. by N. in a current that set S. by W. 27 miles, during that time; what is her true course and distance made good, also her difference of latitude and departure.

To find the Course and Distance made good.

Courses.	Dist.	N.	S.	E.	W.
N.E.b.N.	98	81·5	....	54·4	....
S.b.W.	27	....	26·5	....	5·3
		81·5	26·5	54·4	5·3
		26·5		5·3	
Diff. Lat..		55·0	Dep..	49·1	

With the difference of latitude and departure, her course will be found nearly N. 42°E. and distance about 74m. by Traverse Table.

GREAT CIRCLE SAILING.

Since the introduction of Tables, by which this problem may be solved by inspection, few navigators will take the trouble of working through the necessary calculations for obtaining the shortest spherical distance between the port they are leaving, and that to which they are bound. Some explanation of its principles is, however, desirable, that the nature of this sailing may be better understood.

Great Circle Sailing is the method of finding the successive latitudes and longitudes which a ship must make, the courses she must steer, and the distances to be run on such courses, so that her track may be nearly on the arc of a great circle, passing through the place sailed from, and that to which she is bound.

The earth being supposed an exact sphere, the shortest distance between two places, is the arc of a great circle intercepted between them, and therefore the distance sailed upon a direct course from one place to another, will always be longer than the arc of a great circle contained between them, except when the rhumb line coincides with a great circle, which can only happen when the ship sails on a meridian, or on the equator. Although it is impossible to make a ship describe an arc of a great circle, yet she may be kept so near to it, that the error will be almost insensible.

The terms that enter into this sailing are, the latitudes of the places, their distance, difference of longitude, and the angles contained between the distance and the meridians of the places, called the *angles of position,*

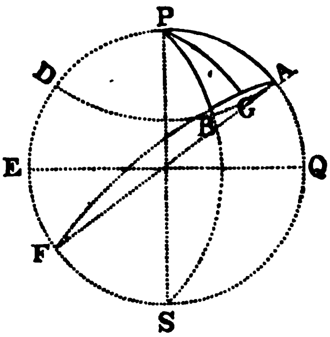
Mercator's Sailing resolves all the cases incident to a ship's course along the rhumb line passing through two places; but, as there is no case in which the course along the direct rhumb line indicates the shortest distance between two places, except when both are under the same meridian, or on the equator, the distance, except in this case, obtained by that sailing, will always exceed the true distance; and the nearer the places are to a parallel of latitude, and the further they are from the equator, the greater will be the error.

To find the distance between any two places and the angle of position.

Given the latitudes of two places on the same parallel, and their diff. long. to find the distance and the angle of position.

Example. Required the angle of position, and the distance between St. Mary, in latitude 36° 57'N. long. 25° 9'W. and Cape Henry, in latitude 36° 57'N. and longitude 76° 27'W.

By Construction.



Describe the circle EPQS to represent the meridian of one of the places, draw the equator EQ and the earth's axis PS, at right angles to it; make ED QA each equal to the chord of 36° 57′ the given latitude, and draw the parallel of lat. ABD, the radius of which is the tangent of 53° 3′ the co-latitude; describe the meridian PBS with the secant of 51° 18′ the diff. of long.; then A and B will be the two places: draw the diameter AF, and through the points ABF describe a great circle; then the arc AB will be the distance, and the angle PAB the angle of position; these being measured, will be found equal to 40° 28′ and 73° 54′ respectively.

By Calculation.

From P, draw PG, perpendicular to AB by describing the arc with the secant of half the diff. of long.; then in the right-angled spherical triangle AGP, are given AP, =53° 3′, the complement of lat. and the angle APG, = 25° 39′ half the diff. of long., to find AG, half the distance and PAG, the angle of position.

To find the dist.

As radius..............		10·00000
: sine AP,	53°3'....	9·90263
:: sine APG,	25 39....	9·63636
: sine AG	20 14....	9·53899
	2	
dist. AB.....	40 28	

To find the ∠ of position.

....	10·00000
: cosine AP...........	9·77896
:: tang. APG..........	9·68142
: cotang. PAG 73°54'.. the ∠ of position.	9·46038

The ∠ PBG = PAG.

Had the places been situated in different latitudes, the angles of position must have been found at both; and the ∠ APG being, in this case, not half the difference of longitude, the operation would have been more difficult.

It is evident, that in order to sail on the arc of a great circle, a ship must continually alter her course, but as this would be attended with trouble and inconvenience, too great to be admitted in the practice of Navigation, it has been thought sufficiently exact to effect this by a kind of approximation, namely, by determining a certain number of latitudes and longitudes through which the ship should pass, with the relative courses and distances between them, on the principle, that in small arcs, the difference between the arc and its chord or tangent is so small, that the one may be substituted for the other without producing any sensible difference between the track thus described and the true spherical track; therefore the smaller the differences of longitude at which the course is altered, the nearer will be the track thus determined, to the truth.

Upon this principle, the great circles on the earth are supposed to be made up of short right lines, each of which is a segment of a rhumb line, and on this supposition the solution to the following problem is founded.

Problem. Given the latitudes and longitudes of two places, to find the several points in a great circle, passing through them, which differ in longitude from either of the places by a given quantity; together with the courses and distances between these points.

Rule. Compute the distance of the places and their angles of position by the preceding problem, find also the highest latitude which the great circle touches, that passes through the two given places, or the perpendicular from the pole to the great circle passing through the given places, and the angles at the pole made by the given alterations of longitude between the perpendicular, and the successive meridians come to.

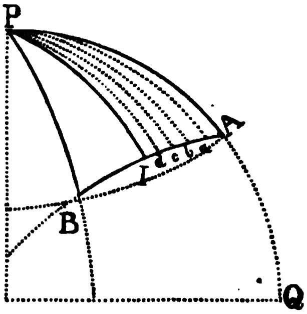
With this perpendicular and the polar angles severally, find as many corresponding latitudes as follows:—

As rad. : co-tang. perp. : : cos. 1st. pol. ang. : tang. 1st. lat.
„ „ : : cos. 2nd. pol. ang. : tang. 2nd. lat.
and so on with the rest.

Now having the latitudes of the several points in the great circle, and the diff. of long. between them, find the several courses and distances, and they will be the courses and distances the ship must run to keep nearly on the arc of a great circle.

Example. A ship from a place A, in lat 37° 0′N. long. 23° 0′W. bound to a place B in the same lat. and in long. 76° 27′W. intends to sail as near the arc of a great circle as she can, by altering her course at every 5° of long.; required the lat. of each point where the course is proposed to be altered, and also the courses and distances between these points.

By Construction.



Describe the triangle APB and compute the dist. as in the preceding problem, when it will be found to be 42° 6′ and the angle of position A or B = 73° 9′; the triangle APB being isosceles, the perpendicular PI falls in the middle of AB, and the latitudes, courses and distances being known in the half AI, those in the other half IB, will also be known. Let the points *a*, *b*, *c*, *d*, &c. be the points arrived at on each alteration of 5° of long.; then will the arcs P*a*, P*b*, P*c*, P*d*, &c. be the respective co-latitudes of those places, and be the hypothenuses of the right-angled spherical triangles PI*a*, PI*b*, PI*c*, PI*d*, &c.

To find the perpendicular PI.

Say, as rad. is to cosine of half the polar angle, or half difference of longitude, so is tang. of PA or PB, the co-latitude, to tangent of PI, the perpendicular; and hence the complement of PI is the latitude of vertex, or highest latitude which the ship comes to at I.

See the application of this rule in the example.

In the triangle PIB are given PB = 53° 0′ the angle of position PBI = 73°9′, to find the perpendicular PI, I being the vertex of the great circle of which the arc AB is a part.

By the 1st. rule.		By the 2nd. rule.*	
As radius - - - - - -	10·00000	radius - - - - - -	10·00000
: sine of PBI 73° 9′ -	9·98094	: cos. 26° 43½′ - - -	9·95093
:: sine of PB 53° 0′ -	9·90235	:: tang. 53° 0′ - - -	10·12289
: sine of PI 49° 51′ -	9·88329	: tan.PI 49° 51′ - - -	10·07382

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* In most cases, this method is preferable, being altogether independent of the angle of position, and requiring only the lat. and diff. of long.

Having found the perpendicular PI, the angle of position PAI, or PBI, may be easily found thus:—

As sine half dist. AI or BI, is to sine half polar angle API or BPI, so is sine perp. PI, to sine angle of position PAI or PBI.

To find the distance.

As rad.	....	10·00000
: sin. PA	53°	9·90235
:: sin. API	26°43½′	9·65293
: sin. AI	21° 2·9′ ...	9·55528
	2	
dist. ..	42 5·8 = 2525·8	

To find the ∠ of position.

As sin. 21° 2′ 9″(cosec.) ..	0·44472
: sin 26° 43½′........ ...	9·65293
:: sin. PI 49° 51′	9·88330
: sin. PAI 73° 9·2′.....	9·98095

the ∠ of position is therefore 73° 9·2

The angle IPA $=(\frac{53^\circ\ 27'}{2})$ 26° 43½′ angle IPa = 21° 43½′, IPb = 16° 43½′ angle IPc = 11° 43½′ angle IPd = 6° 43½′ are the several polar angles.

To find the latitude of the point a.

As radius	- - - - -	10·00000
: cos. 1st pol. ang.	21°43½′	9·96800
:: cotang. PI	49°51′	9·92612
: tang. 1st. lat.	38° 5′	9·89412

By continuing the operation with the other polar angles, the successive latitudes from a to I, will be found to be 38° 56′, 39° 33′, 39° 57′.

Now with the several latitudes and respective differences of longitude, compute the courses and distances, and enter them in a Table, as follows:

Polar Angles.	Successive Long.	Diff. Long.	Successive Latitude.	Diff. Lat.	Merid. Parts.	Mer. diff. lat.	Courses.	Distances by Mid, Lat. Sailing.	Distances by Mercator's Sailing	Distances by Spherical Trigony.
° ′		′	° ′	′			° ′			
IPA = 26 43½	23 0		37 0		2392·6					
IPa = 21 43½	28 0	300	38 5	65	2474·6	82·0	74 43	246 6	246·6	246·6
IPb = 16 43½	33 0	300	38 56	51	2539·8	65·2	77 44	240·2	240·0	240·2
IPc = 11 43½	38 0	300	39 33	37	2587 6	47·8	80 57	235·3	235·2	235·1
IPd = 6 43½	43 0	300	39 57	24	2618·8	31·2	84 4	231·9	232·2	232·0
	49 43½	403·5	40 9	12	2634·5	15·7	87 46	309·1	307·9	309·0
		1603·5		189		241·9		1263·1	1261·9	1262·9 2
										2525·8

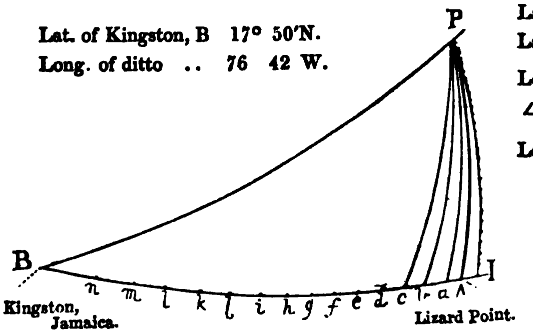
The true distances of the respective lats. from vertex or perp. are found by the same formula, as the total distance above, and the differences are the numbers in the last column.

The courses and first distances are found by Mercator's Sailing; but as the other courses are near the parallel, the distances cannot be very exactly found by this method. The sum of the distances is 1263·1 which doubled gives the whole distance 2526·2.

The sum of the several successive differences of longitude = 1603·5 × 2, gives 3207 miles the whole diff. of long. between the two given places, the sum of the successive diff. of latitude = 189 × 2, gives 378 miles which is equal to the whole diff. of lat. comprehended under the highest latitude at which the ship should arrive, and the latitudes of the two given places; and the sum of the several meridional differences of lat. = 241·9 × 2, gives 483·8 miles agreeing exactly with the whole mer. diff. of latitude corresponding to the highest latitude, and the latitude of the two given places.

Example 2. A ship bound for *Kingston*, in *Jamaica*, takes her departure from the *Lizard*, in latitude 49° 58′N. longitude 5° 12′W. and wishes to sail upon a great circle of the sphere, as nearly as possible, until she reaches her destination in latitude 17° 50′N. and longitude 76° 42′W.; what courses and distances must she make good to accomplish her purpose: supposing her first course from the Lizard to continue until she shall have made 1° 30′ long. W. of the Lizard; and every successive course, until she shall have reached her destination, to be changed at the end of every 5 degrees of longitude.

Lat. of Kingston, B	17°	50′N.
Long. of ditto ..	76	42 W.



Lat. of Lizard, A.	49°	58·0′N.
Lat of Vertex, I.	50	0·1
Long. of Lizard .	5	12·0 W.
∠ I P A.......	2	50·4
Long. of Vertex, I	2	21·6

I A = 1° 49·5′ = 109·5′, or 109 5 nautical miles on the great circle, of which B A I forms a part.

B A - -	64°	36′	39″	= 3876·6 miles, computed
B I - -	66	26	10	computed
A I - -	1	49	31	
B P - -	72	10·0		given
A P -	40	2·0		co lats.
I P - -	39	59·9		computed
Lat I -	50	0·1		by consequence
Long I -	2	21·6		,,
Polar ∠ BPI =	74	20	23	computed
Diff. long BPA =	71	30	0	given
Diff = ∠ API -	2	50	·23 or 2° 50·4′	

See p. 108.

We must first compute the angles of position at the Lizard, and at Kingston; thus,—add together the secant of half the sum of the co-latitudes, the cosine of half their difference, and the cotangent of half the difference of longitude, the sum will be the tangent of arc 1, or half the sum of the angles of position.

Again, add together the co-secant of half the sum of the co-latitudes the sine of half their difference, and the cotangent of half the difference of longitude, the sum will be the tangent of arc 2, or half the difference of the angles. Then, the half sum or arc 1, added to the half difference, or arc 2, will give the greater angle of position; and arc 2 deducted from arc 1, will give the less angle.

	Operation.		
Co lat. of Lizard -	40° 2′	longitude of Kingston -	76° 42′W.
co lat. of,Kingston	72 10	longitude of Lizard -	- 5 12 W.
		diff. long.	- 71 0

s—sum -	112 12	½=56° 6′	sec.	0·253564	cosec.	0·080915
d—diff. -	32 8	½=16 4	cos.	9 982696	sin...	9·442096
P—diff. long.	71 30	½=35 45	cot.	0·142730	cot...	0·142730
		67° 19′ 22″	tan.	10·378990	tan...	9·665741
		24 51 8				24° 51′ 8″
∠ from North - -		92 10 30	greater ∠ of pos. at Lizard=S.87°49′30″W			
∠ from North - -		42 28 14	less ∠ of pos.at Kingston=N.42°28′14″E·			

Hence the true bearing of Kingston from the Lizard, is S. 87° 49′ 30″ W. and of the Lizard from Kingston, N. 42° 28′ 14″E. the difference of these bearings is 45° 21′ 16″, and is called the *convergency* of the meridians of the Lizard and of Kingston. The bearing at either place, being known, the *reverse* bearing, or reciprocal bearing at the other place may be computed thus;—add together the tangent of half the difference of long. the sine of half the sum of the latitudes, and the secant of half the diff. of lat. the sum will be the tangent of *half the convergency of the meridians*; this angle doubled will give the *convergency*, which applied by addition or subtraction to the given bearing, or angle of position, will give the *reciprocal bearing*, or the other angle of position. In north latitude the south bearing is greater than its reverse bearing north, because the meridians diverge towards the south, but converge towards the north. In south latitude the case is similar; for in either hemisphere, the meridians diverge from the nearest pole, but converge as they approach the nearest pole. Hence if the given bearing be S.E. or S.W. the *convergency* must be subtracted from it, in order to obtain the *reverse* bearing N.W. or N.E.

To compute the *convergency* in the present case,

Half diff. long - - -	35° 45′	tan.	9·857270
Half sum of lats. - -	33 54	sin.	9 746436
Half diff. of lats. - -	16 4	sec.	0·017304
Half convergency	22° 40′ 38″	tan.	9·621010
	2		
convergency	45 21 16	the same as the diff. of the bearings given above.	

Now suppose the bearing of Kingston from the Lizard to have been known, or already computed as above, namely, S.87° 49′ 30″W. from this bearing subtract the convergency, 45° 21′ 16″, and the remainder, 42° 28′ 14″, will be the bearing of the Lizard from Kingston, N.E. This independent computation of the *convergency* of the meridians, will always be a test of the correctness of the angles of position.

As the angle of position at the Lizard is greater than a right angle, the perpendicular PI falls without the triangle PBA, east of the Lizard; and therefore the series of latitudes of the points *a, b, c, d, &c.* as well as the distances A*a*, *ab*, *bc*, *cd*, &c. must be referred to the position of vertex I, as the initial point.

To compute the perpendicular PI, and the base BI, in the right-angled spherical triangle PBI,

∠ PBI = 42° 28′ 14″ .. cos. 9·867835 .. sin. 9·829439
PB = 72 10 0 .. tan. 10·492540 .. sin. 9·978615 (= PI

BI = 66 26 10 tan. 10·360375 sin. 9·808054 = 39° 59′ 55″

rad. : cos. PBI :: tan. PB : tan. BI = 66°26′10″ = 66°26·2′
rad : sin. PBI :: sin. PB : sin. PI = 39 59 55 = 39 59·9
sin.PI : sin. PBI :: sin. BI : sin. BPI = 74 20 23 = 74 20·4

74° 20·4′—71° 30′ = 2° 50·4′ = diff. of long. of Lizard and Vertex I. hence,

	90° 0·0		5° 12·0′W.
perp. PI =	39 59·9	∠ API =	2 50·4
lat. of vertex -	50 0·1 N.	long. - -	2 21·6 W.

It is presumed needless to give the above formulæ in words.

To find the whole distance, BA.

As sin. ∠ PBI 42°28′14″(cosec) 0·170561
: sine PA 40°2 - - - - 9·808368
:: sine polar angle 71 30 - - 9·976957

: sine BA 64°36′39″ - - - 9·955886

To find AI, the dist. between the Lizard and the Vertex I.

As radius (sin. of 90°) - - -	10·000000	Or, rad. - - - - - - -	10 000000
: sinePA 40°2′(co-lat of Lizard)	9·808368	: cos. 87°49′30″ (= ∠ PAI) -	8·579232
:: sine ∠ API 2°50·4′ · - -	8·695018	:: tan. PA 40° 2′ - - - -	9·924327
: sine AI 1° 49′ 35″ , - -	8·503386	: tan AI 1°49′34″ = 1°49·6′nrly.	8·503559

These last computations prove the distance, and also each other; for,

BI = 66° 26·2′
AI = 1 49·6

BA = 64 36·6
Also BA = 64 36·6 computed independently above.

Now, to find the several latitudes of those points in the great circle, at which the courses are to be altered, compute as before directed, thus:—

Diff. long. between I and *a*=4° 20 4′=2° 50·4′ + 1° 30′

As radius - - - - - 10·000000
: cot. perp. PI 39° 59′ ·9 - 10·076212
:: cos. IP*a* 4° 20·4′ - - - 9·998754

: tan. lat 49° 55′ 14″ or 49°55·2 10·074966

The calculation of the latitudes may be considerably facilitated by the following method, placing the co-tangent of PI, as a constant quantity at the head of the column, adding thereto each successive *cosine*, and writing the sum, opposite its cosine, in the column of tangents, and lastly taking out the corresponding latitudes, and placing them opposite the respective tangents, in another column, as in the annexed table.

Log. cot. P I = 10·07621 Lat. of Vertex I = 50° 0·1′

Longs. from Vertex.	cosines.	tangents.	latitudes.	diff. lats.
I P *a* =4° 20·4′ ..	9·99875 =	10·07496 ..	49° 55·2′	0° 4·9′
I P *b* = 9 20·4 ..	9·99420	10·07041 ..	49 37·5	0 17·7′
I P *c* =14 20·4 ..	9·98625	10·06246 ..	49 ·6·4	0 31 1
I P *d* –19 20·4 ..	9·97477	10·05098 ..	48 21·3	0 45·1
I P *e* =24 20·4 ..	9·95957	10·03578 ..	47 21·4	0 59·9
I P *f* =29 20·4 ..	9·94038	10·01659 ..	46 5·6	1 15·8
I P *g* =34 20·4 ..	9·91682	9·99303 ..	44 32·4	1 33·2
I P *h* =39 20·4 ..	9·88840	9·96461 ..	42 40·1	1 52·3
I P *i* =44 20·4 ..	9·85443	9·93064 ..	40 26 6	2 13·5
I P *j* =49 20·4 ..	9·81396	9·89017 ..	37 49·9	2 36·7
I P *k* =54 20·4 ..	9·76565	9·84186 ..	34 47·5	3 2·4
I P *l* =59 20·4 ..	9·70752	9·78373 ..	31 17·4	3 30·1
I P *m* =64 20·4 ..	9·63652	9·71273 ..	27 17·9	3 59·5
I P *n* =69 20·4 ..	9·54756	9·62377 ..	22 48·4	4 29·5
I P B =74 20·4 ..	9·43125	9·50746 ..	17 50·0	4 58·4

Having now determined the latitudes of the points *a*, *b*, *c*, *d*, &c. the distances A*a*, *ab*, *bc*, &c. may be found either by middle latitude, or by Mercator's Sailing; and so may the courses also be obtained from the same methods. It may be useful to observe here, that when the diff. of lat. is very small, which happens to be the case near the lat. of vertex, the difference of long. is so much greater than the meridional difference of latitude, that Mercator's Sailing should not be used, being liable to a considerable error in the distance; nor is Middle latitude sailing free from the same objection, because the proper diff. of lat. bears no sensible ratio to the difference of longitude. Thus, in the case before us, the difference between the lat. of vertex, 50° 0·1′, and the latitude of the Lizard 49° 58′, is only 2·1′, whereas the difference of longitude is 2° 50·4′=170·4′; hence, *tangent course* must be great, and a slight change in the course must make a considerable change in the distance.

Again when the difference of latitude is considerable, say 6 or 8 or 10 degrees, *Middle Latitude Sailing* will not give correct results, unless a correction be applied to the middle latitude, to give the *true mean latitude.* In this case *Mercator's* method is preferable, unless the difference of latitude exceed those limits beyond which both methods will be liable to considerable error: in such cases spherical Trigonometry should be used; or the distances should be broken up into shorter distances, and the courses changed accordingly.

But the most correct method of computing the several distances is by Spherical Trigonometry; and this may, and should be used as a test of the accuracy of the other two methods; it is scarcely more troublesome or more difficult than either of those methods. By means of the several latitudes already determined, and the longitude from the *vertex of the great circle,* the distance from *vertex* to each latitude may be found by the first and the most simple formula of Spherical Trigonometry, as before directed. Thus, taking the first case above;

As rad. : sin. P*a*, or cos. 49° 55·2′ : : sine *polar angle,* or diff. of long. 4° 20·4′ : sine *a*I 2° 47·6′, from which deducting AI=1° 49·6′, we obtain the first distance A*a*=58·0′, corresponding to 1·30 of longitude.

Again,

rad.	- - - - - -	10·000000
: cos	49° 37·5′ -	9·811433
:: sin.	9 20·4 -	9·210299
: sin I *b* =	6 2·1	9·021732
I *a* =	2 47·6	
ab =	3 14·5=194·5′ the 2nd distance from the Lizard.	

The courses as well as the distances, may be computed by spherical Trigonometry; they are computed in the same way as the angles of position; but this method is rather tedious as well as troublesome; the courses obtained by *Mercator's,* or *Middle Latitude Sailing* will be sufficiently correct for all practical purposes.

By another method, different from the above, but similar to that which has been given for computing the latitudes, the distances may be briefly computed by spherical Trigonometry, as follows:—

Points on Gt. Circle.	Long. from Vertex.	sin.PI=9·80805·5	tangents.	Distances from Vertex.	Distances between A & B.	2nd Diff.
1	2°50·4	tan. 8·69555	= 8·50360	1°49·6=I A		
					0 58·0=A*a*	
2	4 20·4	8·88020	= 8·68825	2 47·6=I *a*		
					3 14·5=*a b*	
3	9 20·4	9·21610	= 9·02415	6 2·1=I *b*		3·3
					3 17·8=*b c*	
4	14 20·4	9·40763	= 9·21568	9 19·9=1 *c*		5·1
					3 22·9=*c d*	
5	19 20·4	9·54528	= 9·35333	12 42 8=I *d*		7 1
					3 30·0=*d e*	
6	24 20·4	9·65548	= 9·46354	16 12·8=I *e*		9·1
					3 39·1=*e f*	
7	29 20·4	9·74981	= 9·55786	19 51·9=I *f*		11 5
					3 50 6=*f g*	
8	34 20·4	9·83453	= 9·64259	23 42·5=I *g*		13·9
					4 4·5=*g h*	
9	39 20·4	9·91363	= 9·72169	27 47·0=I *h*		16·6
					4 21·1=*h i*	
10	44 20·4	9·98999	= 9.79805	32 8·1=I *i*		19·3
					4 40·4=*i j*	
11	49 20·4	10·06605	= 9·87410	36 48·5=I *j*		22 4
					5 2·8=*j k*	
12	54 20·4	10·14417	= 9·95222	41 51·3=I *k*		24·8
					5 27·6=*k l*	
13	59 20·4	10·22708	=10·03514	47 18·9=I *l*		27·0
					5 54·6=*l m*	
14	64 20·4	10·31839	=10·12644	53 13·5=I*m*		28·1
					6 22·7=*m n*	
15	69 20·4	10·42358	=10·23163	59 36·2=I *n*		27 3
					6 50·0=*n* B	
16	74 20·4	10·55232	=10·36038	66 26·2=IB		
				Total dist. AB=	64 36·6=3876·6′	

or 3876·6 nautical miles.

This is a very convenient form for tabulating the results.

The *formula* by which these computations for distances have been made, is deduced from *Napier's Rules*, and is very simple; it runs thus,—

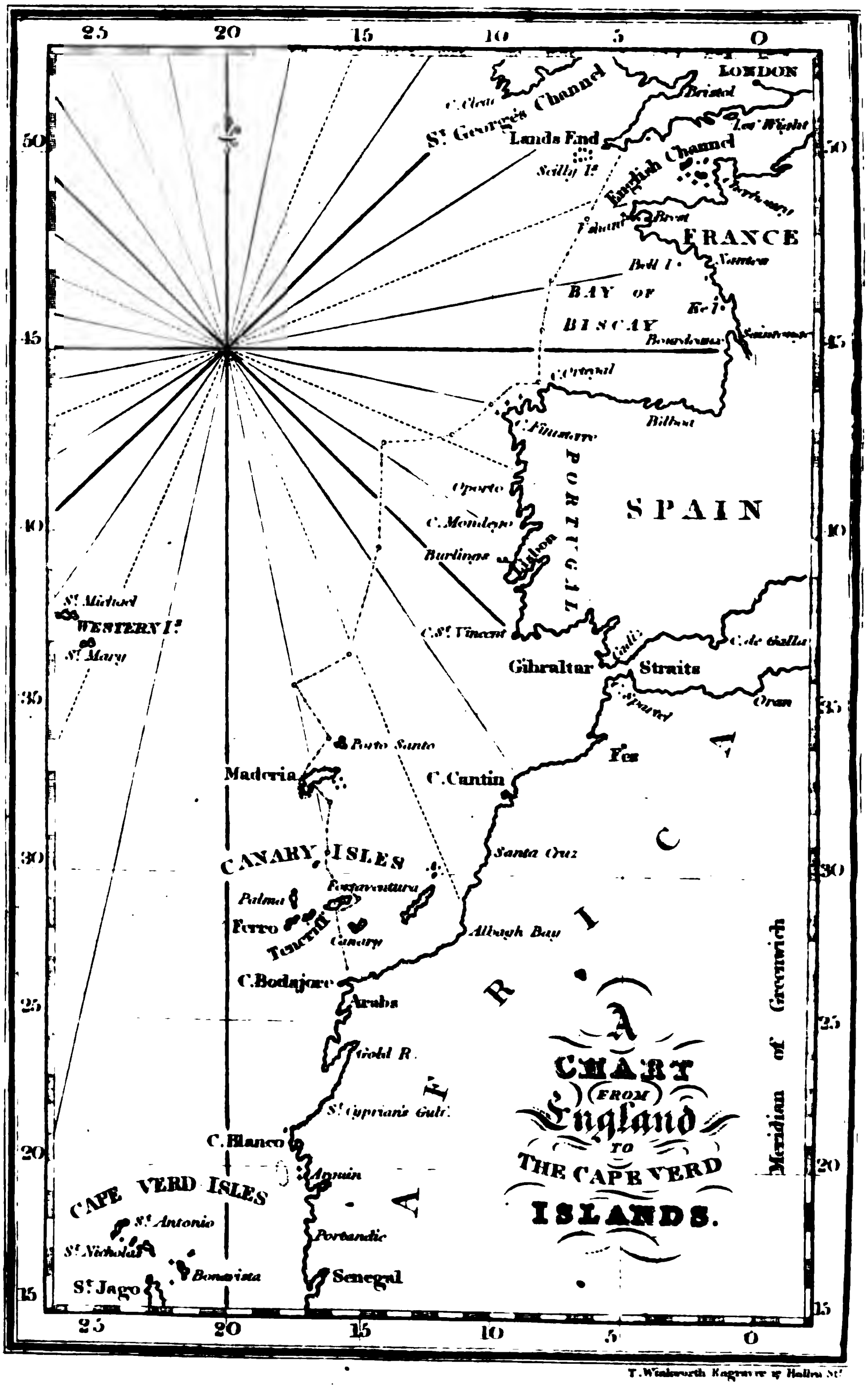
As rad. : sin. perp. PI : : tan. polar angle : tang. opposite side, or dist.

This formula for computing the distances from *vertex*, spherically is preferable to that already given; because the distances thus obtained from the perp. and polar angles, are likely to involve fewer errors than those derived from the latitudes and polar angles, inasmuch as the latitudes have been previously deduced from the same data, and are therefore liable to some small errors.

The following Table exhibits the final results for latitudes, courses and distances, as determined by *Spherical Trigonometry and by Mercator's and Middle Latitude Sailing.*

Nos.	Points.	Long. from Vertex, W.	Long. from Greenwich W.	Diff. Long	Latitudes on Great Circle.	Diff. Lat.	Meridnl. Parts.	Courses, South-westerly.	Distances by Spherical Trigonometry.	Distances by Middle Latitude Sailing.	Di by ca Sa
		° ′	° ′		° ′	° ′		° ′	′	′	
Vrtx	I	0 0·0	2 21·6	....	50 0·1	......	3474·6				
						0 2·1					
Liz.	A	2 50·4	5 12·0	....	49 58·0	......	3471·4	S 87 14 W	58·0	58·0	
				90		0 2·8					
1	*a*	4 20·4	6 42·0	....	49 55·2	......	3467·0	,, 84 47 ,,	194·5	194·5	1
				300		0 17·7					
2	*b*	9 20 4	11 42 0	....	49 37·5	......	3439·5	,, 80 57 ,,	197·8	197·8	1
				300		0 31·1					
3	*c*	14 20·4	16 42·0	....	49 6·4	......	3391·9	,, 77 5 ,,	202·9	203·0	2
				300		0 45·1					
4	*d*	19 20·4	21 42·0	....	48 21·3	......	3323·5	,, 73 26 ,,	210·0	210·0	2
				300		0 59·9					
5	*e*	24 20·4	26 42·0	....	47 21·4	......	3234·2	,, 69 46 ,,	219·1	219·2	2
				300		1 15·8					
6	*f*	29 20·4	31 42·0	....	46 5·6	......	3123·6	,, 66 10 ,,	230·6	230·6	2
				300		1 33·2					
7	*g*	34 20·4	36 42·0	....	44 32·4	......	2991·1	,, 62 39 ,,	244·5	244·4	2
				300		1 52·3					
8	*h*	39 20·4	41 42 0	..	42 40·1	......	2835·9	,, 59 16 ,,	261·1	261·2	2
				300		2 13·5					
9	*i*	44 20·4	46 42·0	....	40 26·6	......	2657·6	,, 56 2 ,,	280·4	280·5	2
				300		2 36·7					
10	*j*	49 20·4	51 42·0	....	37 49·9	......	2455·1	,, 52 57 ,,	302·8	302·8	3
				300		3 2·4					
11	*k*	54 20·4	56 42·0	....	34 47·5	......	2229·1	,, 50 7 ,,	327·6	327·7	3
				300		3 30·1					
12	*l*	59 20·4	61 42·0	....	31 17·4	......	1978·4	,, 47 31 ,,	354·6	354·6	3
				300		3 59·5					
13	*m*	64 20·4	66 42·0	....	27 17·9	.....	1703·7	,, 45 14 ,,	382·7	382·7	3
				300		4 29·5					
14	*n*	69 20·4	71 42·0	....	22 48·4	......	1406 0	,, 43 18 ,,	410.0	410·0	4
				300		4 58·4					
15 Kingston	B	74 20·4	76 42·0	....	17 50·0	......	1087·7				
									3876·6	3877 0	38

Total distance computed by Spherical Trigonometry = 64° 36′ 39″ = 3876·65 nautical m



A CHART FROM England TO THE CAPE VERD ISLANDS.

T. Winkworth Engraver 9 Hollen St.

ON CHARTS.

The term chart is usually applied to a representation of such portions of the surface of the terraqueous globe, as are composed principally of water; hence charts are frequently denominated *hydrographical maps.*

In these the inland face of the country is left nearly blank, while the *sea coast* only, with the objects it contains of principal importance to the mariner, such as light-houses, beacons, churches, &c. are laid down with great precision, the utmost care being taken to delineate the rocks, shoals, and quicksands in the sea, whereby the safety of ships may be endangered. The depths of water, or soundings of the principal bays and harbours, and the direction of the winds, where they are peculiarly prevalent, together with the variation of the needle, the directions and velocities of the currents, and whatever other particulars may serve to direct the mariner on his voyage, or to warn him of dangers to be avoided, are introduced and marked with the greatest minuteness. In maps, the sea coast is generally shaded, or softened off, from the land towards the sea, but in charts the softening off is in the contrary direction; a want of due attention to which particulars, frequently tends to confuse the unpractised student in the use of charts.

In addition to the above particulars, *plans* of harbours, ports, &c. are frequently constructed on a different scale to the general chart, and inserted in a corner, or in some convenient part of it, for reference when the ship is close in with the land; and on these plans are commonly inserted the leading marks for channels, anchorages, places convenient for landing, and for watering, together with many other useful details.

The charts principally in use among seamen are of two kinds, the *Plane* and the *Mercator's Chart.*

PLANE CHARTS

are constructed on the assumption that the surface of the earth is an extended plane, and when, on these charts, it is attempted to exhibit the latitudes and longitudes of places, the meridians are drawn parallel to each other, the degrees of the parallels, and those of the meridians, being represented as equal to the degrees of the equator; hence the relative positions of different places are so erroneously exhibited, that they are of scarcely any practical utility. When, however, from the small extent of surface intended to be represented, neither latitude nor longitude is considered, no material error will occur; while the magnitude of the scale upon which such small portions of surface can be represented, affords facilities for the insertion of many particulars, which could not be introduced under other circumstances; this is particularly the case in plane coasting charts, on which places are laid down according to their relative positions, and angular distances; and these charts which are designed for the direction of mariners, when near the land, and seldom comprehend any considerable extent of coast, will not deviate much from the truth, either in bearing or distance. The simplicity of their construction renders any explanation of them unnecessary, we shall therefore proceed to the

CONSTRUCTION OF THE MERCATORS CHARTS.

The general principles of this chart having been already described, under the head of Mercator's Sailing, the mechanical mode of construction, is all that is necessary to be given in this place.

Observation. In this chart, as in all other maps and charts, when not otherwise indicated by the *fleur de lis,* the upper side represents the north and the lower the south; the right-hand denotes the east, and the left-hand the west.

If the extent of surface to be represented be wholly in north latitude, draw a line near the bottom of the paper, to represent the lowest latitude but if the surface to be represented be wholly south latitude, draw the line representing the lowest latitude near the top of the paper. Should the portion of the surface to be delineated lie partly in the northern, and partly in the southern hemisphere, draw a line to represent the equator at a proportional distance from the top or bottom of the paper; on the line intended to represent the parallel of the least latitude, lay off the proposed number of the degrees, &c. of longitude, from a scale of equal parts, numbering them at every fifth or tenth degree; this line will become a *general line of measures,* at each extremity of which draw a vertical line, to represent the extreme meridians. Then proceed as follows: from Table 6, take the meridional parts at which it is proposed the chart should commence, and also for each successive degree of latitude it is designed to comprehend. Find the meridional difference of latitude between the lowest parallel and each succeeding parallel intended to be represented in the chart, and dividing them by 60, for degrees, &c. take the quotient from the divided parallel, or line of measures, and apply them on the extreme, commencing at the parallel of the lowest latitude and the degrees of latitude will be thus determined. If the scale of the chart be small, the meridional parts with their differences, may be taken to every fifth or tenth, instead of to every single degree; on the contrary should the scale of the chart be large enough to admit of it, a subdivision may be made, both of the degrees of latitude and longitude.

Having determined the foregoing particulars, the meridians and parallels of latitude are to be drawn at such intervals as may be deemed convenient, and every remarkable place or object, comprised within the limits of the chart, is to be inserted from its known latitude and longitude, together with such other particulars as have been before mentioned as being essential to a marine chart; one or more compasses are also to be drawn in the most convenient parts of the chart, and the rhumb lines extended to the coast; finally, the coasts, &c. are to be properly shaded, and the chart will be completed.

USE OF MERCATOR'S CHART.

To find the latitude and longitude of any place or point on the chart.

With a pair of compasses take the distance of the given place from the nearest parallel, and from the point where that parallel cuts the graduated meridian, lay off the distance upon that meridian, upwards or downwards according as the place may be north or south of the parallel, the point to which the distance reaches, will be the latitude of the place.

In the same manner take the least distance of the given place from the nearest meridian, and from the point where that meridian cuts the graduated parallel, lay off the distance to the east or west of the said meridian, the point to which this distance extends on the graduated parallel, will be the longitude of the place.

Or, the edge of a parallel rule laid over the given place, parallel to the nearest parallel of latitude, will intersect the graduated meridian in the required latitude; the edge of the rule being in like manner applied to the given place, and parallel to the nearest meridian, will intersect the graduated parallel in the required longitude.

From the known latitude and longitude of a place, to determine its position on the chart.

Lay the edge of a scale over the parallel of the given latitude, on one of the divided parallels take the distance of the nearest meridian line from the given longitude, apply this distance in the same direction, from the point where the same meridian line is intersected by the scale, and the point to which the distance reaches, will be the required position of the place.

To find the course or bearing between two places on the chart.

Lay one of the edges of a parallel rule over both the places, then move the two parts of the rule in succession, till the edge of one of them passes through the centre of a compass on the chart, and that edge will indicate the course.

Or, if a pencil line be drawn along the edge of the scale, cutting any meridian, the angle included between the line and the meridian, will be the course.

Or, lastly, having applied the edge of the scale to the places as before place one foot of a pair of compasses in the centre of one of the compasses drawn in the chart, and with the other take the nearest distance, between the centre of the compass and the edge of the scale, carry this extent along the edge of the scale, carefully observing to keep the compasses in such a position, that while one point touches the edge of the scale, the imaginary line between them may be *perpendicular* to that edge, then the line described by that point of the compasses which passes through the compass on the chart, will indicate the course or bearing required.

To find the distance between any two places on the chart.

If the places are on the same meridian, mark the points where their parallels intersect the graduated meridian, at the side of the chart; the degrees and parts comprehended between them, is the difference of latitude, which is also their distance. When the two places are on the same parallel of latitude, take half their distance and lay it off, on the graduated meridian both ways, from that point in which it is intersected by their parallel; the degrees of the meridian intercepted between these two points, will be the distance of the places *nearly.*

But if the places differ both in latitude and longitude, take the distance between them and apply it to one of the graduated meridians, so that one foot of the compasses may be as much above one place, as the other foot is below the other place, the degrees and minutes contained between these two points will be the distance required, which may be reduced to miles in the usual manner.

If, however, the places lie nearly in a parallel, take half their distance and apply it both upwards, and downwards on the graduated meridian, from the middle parallel of latitude between the two places, and the degrees of the meridian contained between the two points, will be the required distance.

The distance between the two places may also be found in the following manner, which is founded on the principles of Mercator's sailing, as resolved by construction.

Find the difference of latitude between the two places, and take it from one of the graduated parallels, then having applied the edge of a scale to the two places, lay the difference of latitude, before taken off, on the meridian, from the latitude of either of the places. Through the point to which this difference of latitude extends, draw a parallel of latitude in pencil, cutting the edge of the scale, and the distance of this point, from the place from whose latitude the difference of latitude was extended, will, if measured on the graduated parallel, be the true distance of the places.

DESCRIPTION AND USE OF INSTRUMENTS.

The Instruments chiefly used for taking the altitudes of celestial objects at sea, and measuring the angular distance between them, are the Quadrant, Sextant, and Reflecting Circle; which being all very similar in general principle, we shall for the sake of brevity, confine our description to the two former.*

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* We shall not attempt anything more than a very general description of these instruments and their uses; proficiency in the method of adjusting which, as well as in taking the observations themselves, is only to be acquired by practice, and that, if possible, under the direction of a skilful observer.

Hadley's Sextant.

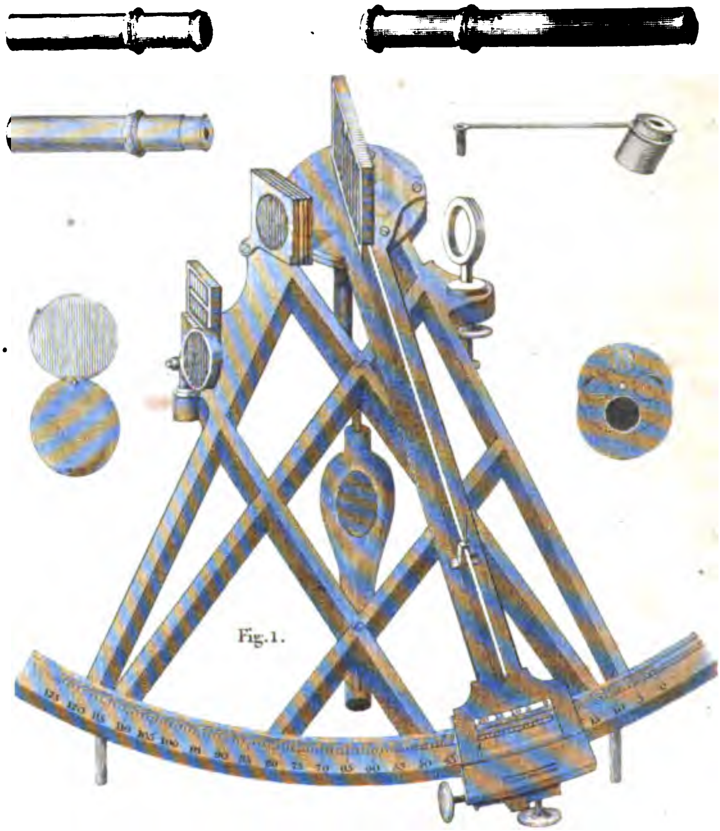
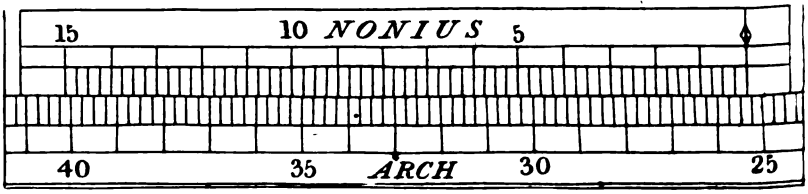


Fig. 1.

Fig. 2.



J. Poplett Sc.

THE QUADRANT.

The frame of which is generally made of ebony, contains an ivory arc of 45° but which on account of the double reflection, is divided into 90 equal parts called degrees, and read off accordingly; these divisions are again subdivided into three equal parts of 20m. each, and which, by means of the vernier or scale attached to the index, may be read off to single minutes.

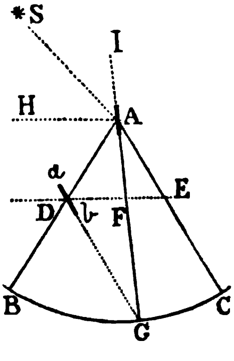
The arc is commonly graduated to a few degrees more than 90; it also extends from 0 a few degrees towards the right-hand, called the *arc of excess*; these parts, however, cannot be properly included in that part of the instrument, which strictly speaking, is called the quadrant:—the same may be observed respecting the sextant.

The quadrant is generally used for taking the altitude of an object, but for measuring the angular distance of the moon from the sun, a star, &c. recourse must be had to

THE SEXTANT.

The frame of which is also sometimes made of ebony, with an ivory arc, but more commonly of brass, or other hard metal. The arc of the sextant (independent of the odd degrees alluded to in describing the quadrant) consists of the sixth part of the circle, or sixty degrees, but is divided into 120°; every degree on those instruments that have ivory arcs, being subdivided into three parts of 20′ each; and these are by the vernier again subdivided into half minutes.

The principle of its construction may be understood better from the following figure and demonstration.



Let ABC represent a sextant, having an index, AG, (to which is attached a mirror at A) moveable about A as a centre, and denoting the angle it has moved through, on the arc BC; also let the half-silvered (or horizon) glass, *a b*, be fixed parallel to AC; now a ray of light, SA, from a celestial object, S, impinging against the mirror, A, is reflected off at an equal angle, and striking the half-silvered glass at D, is again reflected to E, where the eye likewise receives through the transparent part of that glass a direct ray from the horizon. Then the altitude, SAH, is equal to double the angle CAG, measured upon the limb BC, of the instrument.

For the reflected angle BAG, (or DAF) = the incident angle SAI, and the reflected angle *b*DE = the incident *a*DA = DAE = DEA, because *ab* is parallel to AC. Now, HAI = DFA = (FAE + FEA,) and DAE being equal to DEA, it follows that HAI = (DAE + FAE.) From HAI and (DAE + FAE) take the equal angles, SAI and DAF, and there remains SAH = 2FAE, or 2GAC, or in other words, the angle of elevation, SAH, is equal to double the angle of inclination of the two mirrors, DGA being equal to GAC.

Hence the arc on the limb, BC, although only the sixth part of a circle, is divided as if it were 120°, on account of its double being required as the measure of CAB, and it is generally extended to 140°.

On some sextants having metal arcs, a degree is divided into six equal parts of 10′ each, and the vernier reads off to 10″; but more frequently the degrees on the limb, or arc, are divided into four parts, each containing 15′, and the minutes on the vernier into a like number of parts equal to 15″ each.

A portion of the arc of a sextant, thus divided, is shewn in Fig. 2, with the vernier attached; to read off which, or any other angle shewn by the sextant, (properly so called,) it is necessary to observe what division on the vernier exactly coincides with one on the arc; then these minutes and seconds being added to the degree and part of a degree on the limb immediately preceding the 0 on the vernier, will be the value of the angle required; thus, in the figure, the division on the arc which immediately precedes the 0 on the vernier is 25° 15′, and the division on the vernier exactly coinciding with one on the arc, is the second or 30″, to the left of 7′, therefore 25° 15′+7′ 30″=25° 22′ 30″ the angle shewn by the index division. In the same manner may any other angle either on the quadrant or sextant be read off according to the parts into which the degree is divided and subdivided by the vernier.

It sometimes happens, as in finding the index error, &c. that the index division is to the *right* of the 0 on the arc, or *on the arc of excess,* in which case in reading off the minutes and seconds on the vernier, the *terminating* line is to be considered as the zero point, and the divisions are to be counted *backwards* or from left to right: thus, suppose on an instrument, the vernier of which is divided as in the figure, the zero point on the vernier was somewhat more than five divisions to the right of 0, on the arc, and that the second *long* division on the vernier, from the left hand or terminating line marked 15, coincided exactly with a division on the arc, then the whole angle would be 1° 17′, that is, 1° 15′ on the arc of excess, and 2′ on the vernier. As it is highly necessary that the observer should be able to correct the errors of the instrument, we shall now proceed to explain

THE ADJUSTMENTS OF THE SEXTANT.*

To set the Index glass perpendicular to the plane of the sextant.

Hold the instrument horizontally with the face upwards, and having set the index to about 60°, bring the index glass near to the eye; look obliquely into it so as to see the image of the arc, if this image form one unbroken line with the arc itself, neither rising above nor sinking below it, the glass is adjusted, if not, the reflected arc must be gradually brought into the plane of the true arc, by means of the screws at the back of the glass. This adjustment is seldom found to be necessary, the index-glass being in general securely fixed in its proper position by the maker.

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* The adjustment of the quadrant being in all respects similar to these of the sextant, renders any separate description quite unnecessary.

To set the horizon glass perpendicular to the plane of the instrument.

Let 0 on the vernier coincide with 0 on the arc; clamp the index, and holding the instrument horizontally, observe through the glass the marine horizon or other distant object, giving the instrument at the same time a small waving motion, if the reflected image and the real object continue to coincide, no adjustment is required; if the *image* be the *lower*, the glass inclines *forward*, if it be the *higher*, the glass leans *backward*, the position must in either case be rectified by the screws.

To set the horizon-glass parallel to the index-glass, the index being at zero.

The 0 on the vernier being brought exactly to 0 on the arc, hold the instrument in a vertical position, and direct the sight through the sight-vane, to a well defined part of the horizon, or any well defined distant object, then, if the horizon seen in the silvered and transparent parts of the horizon-glass coincide, the horizon-glass is truly adjusted; if otherwise, it is out of adjustment, and must be corrected by means of the screws which are attached to the instrument, (generally at the back,) for that purpose.

This adjustment may also be made as follows, bring the two zeros exactly to coincide, and clamp the index; now screw on the telescope, and by means of the screw at the back of the instrument, bring the telescope into such a position, that its field may be exactly bisected by the line which separates the silvered and transparent parts of the horizon glass.

Hold the sextant vertically, and direct the sight through the telescope to the sea-horizon, then if the reflected and true horizons coincide, the glass needs no adjustment; but if this be not the case, make them to coincide by means of the tangent screw, or the two screws which in some instruments are placed near the horizon-glass for that purpose.

In adjusting by these screws, great care must be taken that when one is slackened, the other must be tightened, in order to prevent the horizon-glass from altering its position, in consequence of the screws not bearing sufficiently against each other. The adjustment made by these screws is less liable to derangement, than that effected by the tangent screw.

To find the Index error.

The most accurate method of doing this, is as follows.—Screw on the inverting telescope, and having adjusted it to the true focus, turn up one or more of the shades, both before and behind the horizon-glass, observing to make the direct and reflected suns, as nearly as possible, of an equal degree of brightness, taking care at the same time to preserve a distinct and well defined edge: bring the 0 on the vernier about 35 minutes to the *right* of 0 on the limb, clamp the index, and holding the instrument in a vertical position, bring the direct and reflected suns in exact contact by the tangent screw, read off the minutes and seconds indicated by the vernier on the *arc of excess*, which call *off*: now set the 0 on the vernier to about 35 minutes to the left of 0, on the arc, then make an exact contact as before, and note down the minutes and seconds *now* shewn by the vernier, which call *on*. If the two readings are alike, there is no index error; if they are unlike, find their difference, half of which is the index error *additive*, when the arc to the *right* of the zero point is greater than to the *left* of it, and *vice versa.*

When the contacts are correctly made, one quarter of that sum will be equal to the sun's semi-diameter, as given in page II of the month, in the Nautical Almanac.

Examples.—1. On observing the sun for the purpose of determining the index error, the indication of the vernier on the arc of excess was 34′ 15″, and on the left of the 0 or zero point 31′ 40″; required the exact error of the instrument.

Off - - - - - 34′ 15″ +
on - - - - - 31 40 —
2) 2 35
Index error - 1 17·5 +

2. Observing for the same purpose, the indications of the vernier were as under; required the index error.

Off - - - - - 30′ 15″ +
on - - - - - 31 35 —
2) 1 20
Index error 0 40—

If at the time of taking the observations, the sun's altitude be less than 20°, his horizontal instead of his vertical diameter, should be taken, on account of the increased refraction near the horizon, whereby his perpendicular diameter is diminished, while his horizontal diameter (which is that given in the Nautical Almanac,) remains unaltered. In this case the sextant is to be held horizontally with the face upwards, and the contact of the reflected with the direct sun, is to be made alternately with the right and left limbs of the latter, in the manner already explained.

To set the axis of the telescope parallel to the plane of the sextant.

Having screwed on the telescope, turn the tube containing the eye-glass till two of the wires are parallel to the plane of the instrument. Select two distant objects, as two stars of the first magnitude, a star and the moon, or the sun and moon, (the latter are to be preferred,) whose distance (in order that the error may be the more obvious,) should not be less than from 100° to 120°; make the contact of the limbs of these objects as perfect as possible at the wire which is nearest the plane of the sextant, and fix the index, move the instrument a little so as to make the objects appear at the other wire, and if the same limbs are still in contact the axis of the telescope is duly adjusted, but if the limbs of the objects appear to separate or partly to cover each other, it shows that the object-end of the telescope inclines *towards* the plane of the instrument in the former case, and declines *from* it in the latter; in the first instance the rectification is made by tightening the screw of the double collar, in which the telescope is fixed, that is nearest the sextant, and slackening the screw which is most distant from it, in the latter instance the operation is reversed.

If the moon be one of the objects, the adjustment must be made very expeditiously, or the moon's apparent motion in the interval must be allowed for.

The sextant is chiefly employed to measure the angular distance between the sun and moon, or the moon and a fixed star; it is also frequently used to take the altitude of a celestial object when great accuracy is required: but altitudes for determining the latitude, are generally taken by the quadrant, which is sufficiently exact for that purpose.

To take an altitude of the sun, &c. at sea.[*]

Set the index to 0, put down one or more screens before the central mirror, according to the brightness of the sun. Hold the instrument perpendicularly, and direct the sight through the sight-vane and horizon-glass, to that part of the horizon which is exactly under the sun. Advance the index gradually forward with the left hand, and the image of the sun will appear to descend towards the horizon; give the instrument a slow vibratory motion round the line of sight, and make the lower or upper limb of the sun just touch the horizon. Clamp the index, and make the contact perfect by turning the tangent screw. The angle then pointed out by the index will be *the observed altitude of that limb which is brought in contact with the horizon.*

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[*] It has not been thought necessary to give any directions for taking an altitude by a back observation, that method being now entirely disused.

For great accuracy, the telescope previously adjusted to distinct vision, should be screwed in after a rough contact has been made, and care must be taken, that the true contact be made in the exact centre of the field.

In the same manner, an altitude of the moon or a star may be taken, observing, that when the moon is the object, her enlightened side whether it be the upper or lower, is to be brought in contact with the horizon.

In order to obtain the *meridian altitude*, the observation should be commenced a few minutes before the object culminates. When brought down to the horizon, it will appear for a few minutes to rise slowly, and is again to be brought in contact with the horizon by moving the index forward, and this operation must be carefully repeated until the object begins to descend, the index is then to be secured, and the angle read off as before directed.

To observe the angular distance between the moon and sun, &c.

When the angular distance between the moon and the sun, a planet or a fixed star is to be observed, the instrument is to be held so that its plane produced may pass through both objects and the eye of the observer. The sight is to be directed to the less luminous of the two, and the reflected image of the other brought in contact with it, exactly in the centre of the fieldof the telescope; it is obvioustherefore, that when the brighter object is to the right of the other, the face of the sextant is to be turned upwards,—the instrument in this case should be supported with the right-hand, and the index moved with the left. But when the brighter object is to the left, the instrument must be held face downwards, and the image of the left-hand object brought to touch the right-hand one seen directly: to effect this, the sextant should be held with the left-hand, and the index guided with the right.

THE ARTIFICIAL HORIZON,

Consists of a horizontal plane, having a perfectly smooth horizontal surface, capable of reflecting back to an eye properly situated for receiving them, the rays of the sun, or other object falling upon it. Such a surface may be obtained in various ways; but the best kind of artificial horizon consists of a small shallow trough or marble basin containing quicksilver, which is protected from the action of the wind by a roof, the opposite sides of which contain plate-glass, the two sides of each plate being ground perfectly plane and parallel. This frame is generally made to fold together, and pack up in a small box, containing also a little bottle of quicksilver, the whole apparatus being thus rendered compact and portable.

This instrument is used in conjunction with the sextant for taking altitudes on shore, for which purpose it is to be placed at a convenient distance from the observer, and in such a position with regard to him and the sun, that he may not only see the sun itself, but also its image reflected from the artificial horizon. The sextant being duly prepared for observation, the upper or lower limb of the sun's image reflected from the horizon-glass, is to be brought into contact with the contrary limb of the image reflected from the artificial horizon. Now, since the image of the object in the quicksilver appears just as much below the horizon as the body itself appears above it, the angle given by the instrument after being corrected for the index error, (if any) will be double the altitude of the observed limb above the horizon; one half of this angle therefore, corrected for refraction, parallax, and semi-diameter, will be the true altitude of the sun's centre.

It must be observed, that when the inverting telescope is used, the upper limb appears as the lower, and the lower as the upper; also, that altitudes exceeding 60° are inaccessible to the common sextant, the limits of which do not extend beyond 120°.

Example. January 11, 1852, upon making a contact between the sun's lower limb reflected from the index-glass of the sextant, and his upper limb reflected from the artificial horizon, the angle on the instrument was 104° 30′ 10″; what will be the true altitude of the sun's centre, the index-error being 1′ 50″ to subtract?

Observed angle	104°	30′	10″
Index error....................	—	1	50
	104	28	20
Apparent altitude ⊙'s l.l.	52	14	10
Correction for refraction and parallax T. 13.........................	—	0	39
Sun's semidiameter, N.A. p II....	+	16	17
True altitude of ⊙'s centre	52	29	48

ASTRONOMY.

Astronomy is that science which treats of the nature and motions of the heavenly bodies, explains the various phenomena which those bodies exhibit, and demonstrates the laws, by which their motions are governed and regulated.

The heavenly bodies may be divided into two great classes, the *fixed*, and *erratic*. The *fixed stars*, are so called, on account of their preserving immutably the same distances and bearings from each other; for although by means of very delicate observations, persevered in through a long series of years, or even ages, astronomers have succeeded in discovering that many of them are in a state of absolute motion, yet this motion is so extremely slow, (even in those stars whose change of place is most perceptible,) that its accumulated amount, even from the earliest times of recorded astronomical observations, has been insufficient to effect any visible alteration, or such as the naked eye can detect, in the uniformity of aspect presented by the starry hosts.

The *erratic* bodies, or those which seem to have a proper motion of their own, and to perform a complete revolution in the heavens in different periods, and in the various paths assigned them, are the Sun, the Planets, and the Comets, which together constitute what is called, the *Solar System*.

THE PLANETARY SYSTEM.

The Planetary System consists of the sun and planets, the latter being divided into three kinds, *Primary Planets, Minor Primary Planets,* and *Secondary Planets,* commonly called *Satellites or Moons.*

The Primary Planets are those which revolve round the sun, as their centre of motion; they are nine in number, their order in the system, and the names and characters by which they are distinguished, being as follow: Mercury ☿, Venus ♀, Terra ⊖ the Earth, Mars ♂, Jupiter ♃, Saturn ♄, Uranus ♅, known also as the Georgium Sidus, and sometimes called Herschel, and Neptune, discovered in 1848.

The Minor Primary Planets are now increased to the number of 12, by the recent discoveries; they revolve round the sun, as a centre, between the orbits of Mars and Jupiter, but are distinguished from the primary planets by their diminutive size, and by the form and position of their orbits.

The planets Mercury and Venus, whose orbits are comprehended by that of the earth, are called *inferior planets,* while the rest of the primary and all the minor primary planets, being more remote from the sun than the earth is, and consequently revolving about him in orbits which, on all sides enclose that of the earth, are called *superior planets.*

The *Secondary Planets* or *Satellites*, are those bodies which revolve round their respective primaries, as their centre of motion, in the same manner as the primary planets circulate about the sun. The number of satellites at present known is twenty; the Moon ☾ which attends on our Earth, four belonging to Jupiter, seven to Saturn, six to Uranus, and two to the newly discovered planet Neptune.

THE SUN ☉.

This stupendous luminary, the great source of light, heat, and vegetation, to the planetary bodies which circulate about him, is an immense globe 883,246 miles in diameter.

Of such a globe we can, of course, form no definite idea: it may, however, assist the student in obtaining something like a distinct conception of its vast magnitude, to know, that were the centre of the sun made to coincide with that of the earth, the solid body of the former would extend nearly twice as far, in every direction, as the moon is from us; in other words, a person at the centre of the sun, in order to reach its surface, would have very nearly as long a journey to perform, as he would in *travelling from the centre of the earth to that of the moon, and back again;* yet this enormous orb, on account of its great distance from us, which may in round numbers be stated at 95,000,000 miles, appears to the eye not much larger than the moon.

Before we proceed to describe the planetary bodies, it will be proper, in order to avoid unnecessary repetitions, to mention a few circumstances which are common to all the planets in the system, whether primary, minor primary, or secondary.

The *orbit* in which a primary planet revolves round the sun, or a satellite round its primary, is not of a circular, but of an elliptical form; and the body about which the revolution is performed, instead of being placed in the centre, is situated in one of the foci of the ellipse.*

Without referring to its geometrical construction, (rules for which may be found in most treatises on practical geometry) an ellipse may be thus mechanically described: Let a thread, having the two ends tied together, be thrown over a couple of pins, fixed upright upon a plane, at any distance apart less than the length of the thread thus doubled will reach, then a pen or pencil carried round within the thread, and keeping it stretched out to its utmost extent, will describe upon the plane an ellipse, which will be more or less elliptical in proportion to the greater or less distance of the pins from each other.

The points in which the pins were fixed are called the *foci* of the ellipse, and have this particular property, that if two right lines be drawn from them to any point in the circumference, the sum of these two lines is equal to the longer axis of the ellipse, or that in which these points are situated.

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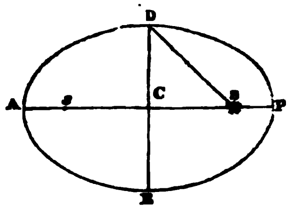
* This subject is particularly worthy the attention of the nautical student, many of the phenomena by which his calculations are affected, resulting from the causes here explained.



Let the ellipse APDE represent the orbit of a planet, the sun is not placed at C, the centre of the orbit, but at S, one of the foci of the ellipse, when the planet therefore is at P, it is in that point of its orbit which is nearest the sun, and is said to be in *perihelion.*

In performing its revolution round the sun, its distance from that luminary gradually increases till it reaches the opposite point A, of its orbit, when. being at its greatest distance from the sun, it is said to be in *aphelion,* when it arrives at the points D and E of its orbit, it is said to be at its *mean distance.*

The points A and P of the orbit, the one of which is farthest from, and the other nearest to the sun, are called the *apsides,* the former of which is denominated the *higher,* and the latter the *lower apsis;* and the line AP, which joins these points, is called the *line of the apsides,* and also the greater or *transverse* axis; DE is the lesser or *conjugate* axis; S the *lower focus,* or that in which the sun is placed, and *s,* the *higher focus,* SC or *s*C the *eccentricity of the orbit,* and SD or SE the *mean distance.*

The mean distance added to the eccentricity is equal to the aphelion distance, SA, and the mean distance, less the eccentricity, is equal to the perihelion distance, SP; consequently the difference between the aphelion and perihelion, or greatest and least distances of a planet from the sun, is equal to double the eccentricity of the orbit of that planet.

In proceeding from its aphelion to its perihelion, the velocity of a planet's motion is continually accelerated, and it is as gradually retarded while the planet is going from its perihelion to its aphelion, its motion being such that an imaginary line drawn from the centre of the sun to that of the planet, (called the *radius vector,*) describes equal areas of the planet's orbit in equal times.

When the sun or moon is nearest the earth, it is said to be in *perigee,* and it is in *apogee* when it is farthest from the earth: the sun is, therefore in perigee when the earth is in perihelion; and in apogee when the earth is in aphelion.

The orbits of some of the planets are more elliptical than others, and most of them are very nearly circular. The line of the apsides of the several planets lie in very different directions, and consequently point to very different parts of the heavens.

The ecliptic is a circle marked out among the stars, by an extended imaginary plane, passing through the earth's orbit, and if we suppose similar planes to pass through the orbits of the other planets, and to be extended to the starry sphere, they will in like manner describe circles thereon, coincident with the orbits of their respective planets.

As viewed from the centre of the sun, each planet would be constantly seen in its own circle, which is thence called its *heliocentric circle,* and the point in which it would be seen at any time, is called the *heliocentric place* of that planet. Now, the ecliptic is obviously the earth's heliocentric circle, if, therefore, the planets all moved in the plane of the ecliptic, they would constantly appear in that circle, which would thus become the heliocentric circle of all the planets, this however is not the case, their circles are all inclined at different angles to the ecliptic; and each of these circles coincides with the orbit of its respective planet, by finding the heliocentric circle of any planet in the sphere of the heavens, the inclination of that planet's orbit to the plane of the ecliptic is known.

The orbit of every planet being inclined to the ecliptic, must intersect the plane of that circle in two opposite points, called its *nodes*; that node from which any planet passes from the south to the north side of the ecliptic, is called its *ascending node*, and that from which it passes from the north to the south side, its *descending node*, the line which joins these points is called the *line of the nodes*.

To an inhabitant of any planet, the sun appears to perform a complete revolution in the heavens, in the heliocentric circle, and in the periodical time of that planet; the apparent motion of the sun being in the same direction as the real motion of the planet.

The situation of a planet in the heavens as seen from the earth, is called its *geocentric* place.

While the primary planets are revolving from west to east round the sun, and the satellites round their respective primaries, these various bodies have at the same time a rotation from west to east on their axes, by which, to a spectator placed upon any one of them, the whole heavens with all the visible bodies contained therein, will appear to revolve round the planet on which he stands, during the time that the planet takes to turn upon its axis, but in a direction exactly the reverse of that in which his rotation is performed.

THE PRIMARY PLANETS,

MERCURY ☿

Is the smallest of all the primary planets, its diameter being only 3224 English miles; its apparent diameter varies from 5″ to 12″. It is also the nearest to the sun, round which it revolves in 87 days, 23 hours, 15 minutes, 43·6 seconds, at the mean distance of about 37,000,000 miles from that luminary.

This planet emits a very brilliant white light, and twinkles like a fixed star, but on account of its proximity to the sun, affords few opportunities for particular observation; yet daily changes have been detected in the appearance of Mercury's horns, from which its diurnal rotation is found to be 24h. 5m. 28s.

The orbit of Mercury is inclined at an angle of about 7° to the ecliptic and the intensity of solar radiation is about seven times greater on that planet than on the Earth.*

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* This is found by dividing the square of the Earth's distance from the Sun, by the square of Mercury's distance from that luminary; light and heat being always as the squares of the distances of the emitting body.

Venus ♀

Is the next planet in the system. Its real diameter is 7687 miles, and its apparent diameter occasionally amounts to 61″, which is greater than that of any other planet, its light is also distinguished by its peculiar brilliancy and whiteness; so intense indeed is the lustre of its illumination, that it completely dazzles the sight, and in a dusky place causes an opaque body to cast a sensible shadow. The mean distance of Venus from the sun is 68,000,000 miles, its revolution about him is performed in 224 days, 16 hours, 49 minutes, 10·6 seconds, and her rotation on her axis is about 23 hours, 20 minutes, 54 seconds.

The inclination of Venus' orbit to the ecliptic, is about 3½°, and the light and heat she derives from the sun, are about twice as great as the earth receives from the same source,

When Venus is seen to the west of the sun, she rises before him in the morning and is then called *Phosphorus*, or the morning star, but when she appears to the east of the sun, she shines in the evening after sunset, and is then called *Hesperus*, or the evening star.

She continues in each of these situations 290 days alternately, which is considerably longer than the whole period of her entire revolution, the cause of which phenomena will be understood from the following description of

The apparent motions of the inferior planets, Mercury and Venus.

These planets are never seen at any great distance from the sun, and Mercury being the nearest to that luminary, and the least in magnitude, is only visible just after the setting of the sun in the evening, or a little before his rising in the morning.

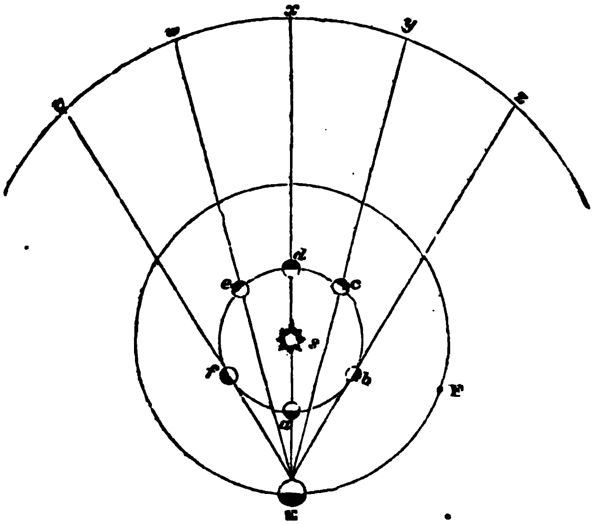
When first seen after sunset in the west, he resembles a brilliant twinkling star, but by continuing our observations during a few succeeding evenings, his distance from the sun will be found gradually to increase till it becomes (at a mean rate) about 22° or 23°; when, having attained his greatest elongation or distance from the sun, he appears for some time stationary, after which he seems to return back again towards the sun, the time that elapses between the setting of which and the planet, (which never exceeds 1h. 50m.) daily decreases, until at length the latter plunges into the sun's rays, and is altogether lost to our sight; shortly after which he will be seen just before sunrise in the morning, his distance from the sun again increases, (but in a contrary direction,) till it is 22° or 23°, when after being a second time stationary, he again returns towards the sun.

Mercury's greatest elongation from the sun varies from about 17° 30′, to 28° 20′.

The apparent motions of Venus are exactly similar to those of Mercury, but, being exterior to that planet, she recedes further from the sun, as seen from the earth, her greatest elongation varying from 44° 57′ to

47° 48′; and from her slower motion, her stations and retrogradations are less frequent than those of Mercury.

To illustrate the foregoing observations, let E, in the annexed diagram represent the earth in its orbit; *a, b, c, d, e, f,* an inferior planet, (say Venus) in several points of her orbit, and *s* the sun. Now as the eye alone will not enable us to form a true estimate of the distances of objects, so remote as the heavenly bodies, Venus being supposed at *a*, the Sun and Venus (if it could be seen,) would both appear to an observer at E, in the opposite point of the heavens, at *x*; Venus however being in *inferior conjunction* with the Sun,—that is between the earth and sun,—will be invisible, because her enlightened side is turned from the earth, unless she be at the time in one of her nodes, in which case she will appear like a dark spot on the sun's disc.



In moving through the arc *ab* of her orbit, she *appears* to recede from the sun westward, through the arc *xyz*. During this time Venus exhibits gradually more and more of her illuminated disc, and when at *z*, having attained her greatest western elongation, she appears half enlightened, like the moon in her first quarter,* her angular distance from the sun being at a mean rate 46°, in this situation she appears to remain for some time stationary, neither receding farther from the sun nor advancing nearer to him; but as she moves from *b*, through *c* to *d*, she appears to return from *z*, through *y*, to the sun at *x*, the illuminated portion of her disc progressively increasing, while her angular magnitude sensibly decreases, and at *d*, being in her *superior conjunction* with the sun, she will disappear behind that luminary.

In going from *d*, through *e* to *f*, she appears to recede from the sun eastward, and at *f* is seen at *v* in the heavens, when having attained her greatest eastern elongation, she again appears for a short time stationary, after which, while moving from *f* to *a*, she seems to return toward the sun, and is again lost to our view.

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* Venus gives the greatest quantity of light to the earth, when her angular distance from the sun is 39° 44′.

The apparent motion of Venus while going from *b* to *f*, in her orbit, or from her western to her eastern elongation, is *direct*, or according to the order of the signs; and while going from *f* to *b*, or from her eastern to her western elongation, it is retrogade, or contrary to that order; but she appears much longer direct than retrograde, because she describes a much larger portion of her orbit in the former instance than in the latter, which is also the reason of her apparent velocity, while moving through the inferior portion of her orbit, being so much greater than while she is describing the superior portion.

While Venus is going from her superior conjunction at *d*, to her inferior conjunction at *a*, she is seen on the eastern side of the sun, as viewed from the earth, and therefore remains above the horizon in the evening after sunset, and from her inferior conjunction to her superior, she appears to the west of the sun, and consequently rises before him, in the morning.

If the earth stood still at E, the planet Venus would seem to make equal vibrations from the sun each way, and her greatest elongations would always take place in the same points of the heavens; but while Venus is proceeding in her orbit in the manner already described, the earth is also advancing in the same direction, from E towards F,—hence the stationary points and places of conjunction, together with the arcs of direct and retrograde motion, are continually advancing forward in the ecliptic; on this account also the planet is seen on either side of the sun for a longer period than that of its whole revolution, and for the same reason, the planet is not stationary at the time of its greatest elongation, but some time after, when the planet is approaching the inferior, and before, when it is approaching the superior conjunction.

The above illustration may be applied, with a little obvious variation, to Mercury, whose greatest elongation at a mean rate is about 22½°

If, when either of the inferior planets come between the earth and sun, the earth happen to be nearly in a line with one of the nodes of that planet, it will appear to traverse the sun's surface like a round spot, exhibiting the phenomenon called a transit; which it is obvious can only be of very rare occurrence, but is of considerable importance, as it affords an easy method of determining the distance of the sun from the earth's centre. The next transit of Venus will take place on the 8th of December, 1874.

The Earth. ⊖

The next planet exterior to Venus is the Earth that we ourselves inhabit, it has a diurnal rotation on its axis, and performs an annual revolution in an elliptic orbit round the sun.

By the first of these motions, the alternate succession of night and day is produced, and by the last, combined with the peculiar position of the earth's axis with respect to the sun, the vicissitudes of seasons are effected.

The Earth is of a round or spherical form, nearly resembling that of a globe. It is, however, flattened at the poles, so that its polar diameter, which is 7899 miles, is 26½ miles less than its equatorial diameter, which is about 7925½ miles; thus the equatorial regions are raised 13½ miles above the polar.

Its distance from the sun is 95,000,000 miles; and moving at the rate of 68,000 miles an hour, performs its annual revolution round the sun in 365 days 6 hours; which motion though 120 times swifter than that given to a cannon ball, is but little more than half the velocity of Mercury in his orbit.

The Earth revolves on its axis in 24 hours, from west to east, and thus occasions an apparent motion of all the heavenly bodies from east to west in the same time.

When any place, by the motion of the earth on its axis, is brought immediately under the sun, the sun is said to be in the meridian of that place, to which it is the noon or mid-day; and all those places which have their noon at the same time, are said to be on the same meridian. The time which elapses between the arrival of the sun at the meridian of any place, and his next subsequent arrival at the same meridian, is called a *solar* or *apparent day*, which is divided into twenty-four solar hours, and these are again subdivided into minutes and seconds. Any portion of this day is called *true apparent* or *solar time*, and is the time we obtain from observation of the heavenly bodies; it is also the time shown by a sun dial. All these phenomena are explained at some length in the Astronomical Definitions.

MARS ♂

Mars is known by his red fiery appearance, which though probably in some degree owing to the nature of his soil, is doubtless principally to be attributed to the density and extent of his atmosphere.

The apparent diameter of this planet varies from 4″ to 18″; its true diameter is 4189 miles, and its distance from the sun, round which he revolves in 686 days 23h. 30m. 35·66, is about 145,000,000 miles. Its rotation on its axis is performed in 24h. 39m. 21s. and its orbit is inclined about 1⅚° to the ecliptic.

JUPITER ♃

Is the largest planet in our system; its real diameter being 89,170 miles; yet, on account of his great distance from us, his apparent diameter varies only from 30″ to 46″, which is his greatest angular magnitude.

The mean distance of this planet from the sun is 494,000,000 miles, and he revolves about that luminary in 4332 days, 14h. 27m. 10·8s. and about his own axis in 2h. 55m. 49s. his orbit being inclined to the ecliptic 1¼°.

The Satellites of Jupiter.

The discovery of Jupiter's satellites by Galileo in 1610, is not only one of the earliest, but also one of the most important improvements, the science of astronomy has derived from the invention of the telescope, for the eclipses of these bodies, which happen very frequently and are easily observed, afford an excellent method of determining terrestrial longitudes on shore.

To these eclipses we are also indebted for the discovery of the aberration of light, and the enormous velocity of its progressive motion, phenomena, which being foreign to the professed object of the present volume, will be passed over without further notice. When viewed through a powerful telescope, these satellites present a most beautiful appearance, being generally ranged in nearly a straight line, almost parallel to his belts.

SATURN ♄

The most remote planet known to the ancients; is not much inferior to Jupiter in magnitude, his diameter being 79,042 miles, and his angular diameter, as viewed from the earth, about 18″. Its annual revolution about the sun is performed in 10,759 days, 1h. 51m. 11·2s. at the mean distance of about 906,000,000 miles, its orbit being inclined to the ecliptic about 2½°.

Saturn revolves on his axis in 10h. 29m. 17s.

Saturn is distinguished from all the other planets of our system, by a luminous ring which encircles his body, and may be classed among the most curious astronomical phenomena with which we are acquainted.

This annular appendage to Saturn, when viewed through very powerful telescopes, is found to consist of two broad flat rings, concentric with the planet, and with each other; they lie in the same plane, and are separated throughout their whole circumference by a narrow interval, and from the body of the planet itself by a very considerable one. The dimensions of these rings are very differently stated by different astronomers.

The rings of Saturn revolve round the same axis, and nearly in the same time as the planet.

Saturn has seven satellites, their orbits nearly coincide with the plane of the ring, except the orbit of the 5th, which is inclined at a considerable angle; this satellite is also much larger than the others.

URANUS ♅

Until 1848 this was thought to be the most remote planet in our system, to which it may be considered a late acquisition, having escaped detection till the year 1811, when it was discovered on the 13th of March, near the foot of Gemini, by Dr. Herschel, who named it the Georgium Sidus, or Georgian Star, in compliment to his munificent patron, King George III, it is, however, now better known by its mythological name Uranus.

It had indeed been observed by Flamstead and Mayer as a fixed star, and as such introduced into their catalogues. Its real magnitude is 35,112 miles, and its angular diameter about 4′, from which, on account of its great distance from us, it never much varies. This planet revolves round the sun in 30,737 days 18 hours, at the distance of 1,822,000,000 miles from that luminary, in an orbit which is inclined about ⅗ of a degree to the ecliptic.

THE MINOR PRIMARY PLANETS.

VESTA ⚶, JUNO ⚵, CERES ⚳, and PALLAS ⚴.

Of the Minor Primary Planets, VESTA is the only one that can be perceived by the naked eye, she appears about the fifth or sixth magnitude, and shines with a more pure white light than any of the other three. The distance of this planet from the sun is in round numbers 225,000,000 miles, and her annual revolution is performed in 1,335 days, 5 hours, the eccentricity of her orbit is 21,015,053 miles, and its inclination to the ecliptic 7⅐°.

JUNO as seen with the telescope, appears like a star of the eighth magnitude; it shines with a red light, and is supposed to have a more dense atmosphere than any of the other three minor planets; its distance from the sun is 253,000,000 miles, and the period of its revolution is about 1,591 days. The orbit of Juno is inclined to the ecliptic at an angle of 13°, and its eccentricity is 65,588,343 miles.

CERES and PALLAS are less red than Juno, and from the nebulous appearance they present, are supposed to be invested with atmospheres of very considerable extent, and but little condensed by the inadequate gravity of the small masses they surround. Their distance from the sun is very nearly alike, and may be stated in round numbers at 263,000,000 miles.

The annual revolution of Ceres is performed in 1,681 days, 13 hours and that of Pallas in 1,681 days 17h. The inclination of the orbit of the former to the ecliptic is 10½°, and that of the latter 34½°, but the orbit of Pallas is much more elliptical than that of Ceres; the eccentricity of the former being 64,516,673 while that of the latter is only 20 598,130 miles.

The apparent motions of the superior planets.

As the orbits of the superior planets comprehend the orbit of the earth, those bodies may be seen in opposition to the sun, and at all possible angular distances from him, they may also be seen in superior conjunction with that luminary, but they can never be in inferior conjunction, and consequently can never have their dark side wholly turned towards the earth, like the inferior planets or the moon when new, They do not however, always appear to move from west to east, according to the order of the signs, as they would be seen to do if viewed from the sun, but like Mercury and Venus, they are sometimes direct, sometimes retrograde, and sometimes stationary.

The motion of a superior planet is direct, when, after being in conjunction with the sun, it is seen to the west of that luminary, rising before him in the morning, its motion is also swiftest at this time, but as the apparent motion of the sun is still more rapid than that of the planet the latter will appear to recede from him, and continues so to do, the velocity of its motion gradually diminishing, till after a certain interval it appears for a few days stationary, after which its motion becomes retrograde, and its velocity now gradually increasing, while the sun is moving in a contrary direction, the angular distance between these two bodies is rapidly augmented, and continues to increase together with the retrograde motion of the planet, till the latter is in opposition to the sun.

After departing from the opposition, the planet is seen to the east of the sun, setting after him in the evening, its retrograde motion continues, and tends to diminish the distance between the sun and planet; the retrograde motion of which, however, now gradually becomes less and less, till at length it altogether vanishes, and the planet again becomes stationary.

After remaining thus for a few days, it resumes its direct motion, which has a tendency to increase the angular distance between it and the sun; the latter however, by the greater rapidity of his apparent motion, gains upon the planet, which, consequently, appears to approach the sun till it is a second time in conjunction with him, after which it emerges from his beams, and reappears in the morning as at first.

These phenomena are common to all the superior planets, but happen under somewhat different circumstances on account of the slower motion of those which are more distant from the sun. The nearer a superior planet is to the sun, the greater will be the time employed by it in passing from conjunction to conjunction; again, the greater the angular distance at which it becomes stationary, and the greater the arc of retrogradation, the less will be the time in which the retrogradation is performed.

The apparent diameter of a superior planet is greatest when that planet is in opposition to the sun, and least when it is in conjunction with him; in the intermediate points of its orbit, its apparent diameter varies between these two extremes, being greater or less according to the proximity of the planet, to the one or other of these situations.

THE MOON

The constant attendant on our earth, and next to the sun, the most useful to us of any of the heavenly bodies, is only 2,160 miles in diameter, yet owing to her proximity to our own globe, her mean distance from which is 237,519 miles, her apparent diameter does not differ greatly from that of the sun.

The moon while revolving round the earth exhibits various appearances, commonly called her phases, which may be thus described: When the moon, after having been in conjunction with the sun, emerges from his rays, she appears in the evening, after sunset, like a fine luminous crescent, having its convex side turned towards the sun; as she recedes from him this crescent gradually increases in breadth, and when she has gone through an eighth part of her revolution she is said to be in her first octant, at which time one-fourth part of her enlightened side is turned towards the earth.

As her distance from the sun increases, she presents more of her enlightened side to our view, and when she has completed a fourth part of her revolution, she appears a half moon, and is said to be a quarter old. In rather less than four days more, she is said to be in her second octant, when she becomes what is termed gibbous, exhibiting an intermediate figure, between a half and a full moon.

Her distance from the sun continues to increase, until at length being in opposition to the sun, her enlightened hemisphere is wholly turned towards the earth, and she exhibits the appearance denominated full moon, at which time she comes to the meridian at midnight.

The enlightened portion of her disc now gradually diminishes, she again becomes gibbous, in passing through her third octant, and when she arrives at her third quarter, only half the enlightened hemisphere is visible; she still continues to approach the sun, again assumes a horned appearance in passing through her third octant, and she is seen in the east rising a little before the sun, till at length having completed her revolution, she is again in conjunction with him and disappears, her dark side being turned towards the earth: the moon in this situation is said to be new.

Those points of the lunar orbit in which she is new and full, or in conjunction and opposition, are called the syzigies, and those points in which she is 90° from the sun, the quadratures. The revolution of the moon from one conjunction with the sun to the next, during which her various phases are exhibited in the manner already detailed, is called a *synodical revolution;* the mean period of which is 29 days, 12h. 44m. 2·8s. which period is also called a lunation.

The *sidereal revolution* of the moon is performed in 27 days, 7h. 43m. 11·5s. being the time she employs in moving from any fixed star to the same fixed star again. The greater length of the synodical revolution, is caused by the motion of the earth in its orbit, whereby the sun appears to advance rather more than 29° in the ecliptic, while the moon goes once round the earth.

The *periodical* or *tropical revolution,* is the time which the moon takes to revolve from one equinox to the same equinox again; it is performed in 27 days, 7h. 43m. 4·7s.

The moon turns exactly once round on its axis, while it performs a synodical revolution in its orbit, as is evident from her always presenting (certain small variations excepted) the same side to the earth.

OF ECLIPSES.

An *eclipse of the sun* as it is generally but erroneously called,* is caused by the dark body of the moon passing immediately between the earth and the sun, whereby his rays are so intercepted, that certain portions of the earth's surface are partially or wholly deprived of his light, causing in fact *an eclipse of those parts of the earth* where the moon's shadow or penumbra falls.†

An eclipse of the moon is caused by her falling into the earth's shadow, whereby (being an opaque body. and having no light of her own,) she undergoes a real eclipse by the interception of the sun's rays.

An eclipse of the sun therefore, can only happen at the time of conjunction, or when the moon is new, and an eclipse of the moon, at the time of opposition, or when she is full. Now, the moon being in these situations once in the course of every lunation, if the moon's orbit coincided with the plane of the ecliptic, a solar and lunar eclipse would happen every month. But since the plane of the moon's orbit is inclined at an angle of about 5¼° to that of the ecliptic, these phenomena can only take place when the moon is in or near one of her nodes, at the time of new and full moon.

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* There is no such thing, properly speaking, as an eclipse of the sun; the phenomenon described under that name is, in fact, an occultation, or hiding wholly or partially of that luminary, (whose brilliancy nevertheless always remains unimpaired,) by the interposition of the moon.

† The planets and satellites are all of them opaque bodies, illuminated by the sun; it follows therefore, that every planet, whether primary or secondary, must cast a shadow towards that part of the heavens which is opposite to that luminary. If, therefore, the earth or any other planet were equal in magnitude to the sun, its shadow would be cylindrical, or if it were larger than the sun, the shadow would assume the figure of a truncated cone, and in either case would be infinitely extended. The sun however being so much larger than any of these bodies, the shadow of every one of them must be of a conical form, growing less and less the further it recedes from the planet, till it terminates in a point, which is the vertex of the cone. The height of the conical shadow of any planet, or the length of the axis of that shadow, is greater or less, as the planet is at a greater or less distance from the sun, thus the conical shadow is longest when the planet is in aphelion, and shortest when it is in perihelion, the primary planets however can never eclipse one another, the magnitude of the sun, and the distances of the planets being such, that a primary planet can only eclipse its satellite, or be eclipsed by it.

When the moon is *in* either of her nodes at the time of new or full moon, the sun, moon, and earth are in the same right line; that is, the line of the moon's nodes coincides with the line of the syzigies; if therefore the moon be new when this coincidence takes place, her shadow will fall upon the earth, and there will be a central eclipse of the sun; if full the earth's shadow will fall upon her, and there will be a total and central eclipse of the moon. If the distance of the moon from either of her nodes at the time of conjunction be less than 18°, the sun may be partially eclipsed, or if she be within 12° of her nodes at the time of opposition there may be an eclipse of the moon: but if the moon's distance from her node exceed those limits, there can be neither a solar nor a lunar eclipse.

In a partial eclipse of the sun a *penumbra*, or imperfect shadow of the moon, falls upon that part of the earth whence the eclipse is seen.

The moon's orbit being elliptical, and the earth placed in one of the foci of the ellipse, her distance from the earth must vary in every point of her orbit. When the moon is at her *mean* distance from the earth, her apparent diameter is exactly equal to that of the sun; when the moon's distance from the earth is greater than her mean distance, the apparent diameter of the sun exceeds that of the moon; but when it is less, her apparent diameter is greater than that of the sun.

When therefore the moon changes about her node, and at her mean distance from the earth, there will be a total eclipse of the sun to that small spot whereon her shadow falls; but if the moon's distance from the earth when she changes in her node, be greater than her mean distance, her apparent diameter subtending a less angle than that of the sun, and her shadow terminating in a point at some distance from the earth, she cannot hide his whole disc from any part of the earth's surface, but to those parts over which the point of her conical shadow passes, there will be what is called an *annular* eclipse; that is, the edge of the sun will appear like a luminous ring, surrounding the body of the moon.

If the distance of the moon be less than its mean distance when the change takes place, her apparent diameter being greater than that of the sun, there will be a total eclipse of that luminary; and as the moon's disc will not only cover the sun, but will moreover extend some distance beyond it, the total darkness will last for some few minutes; as however the moon's apparent diameter, when largest, exceeds that of the sun when least, by only 2′ 5″ of a degree, the total darkness can never continue longer than 4 min. 6 sec, which is the time the moon takes to move through that space.

The moon's dark shadow, when the sun is farthest from the earth, and she is nearest to it, never extends over a circular space upon the earth's surface exceeding 180 miles in diameter, but her partial shadow or penumbra, may then cover a circular space 4,900 miles in diameter, within every part of which the sun is seen more or less eclipsed, as the places are more or less contiguous to the centre of this shadow; no solar eclipse therefore is universal or visible throughout the whole of that hemisphere which is turned towards the sun at the time.

When the moon goes through the centre of the earth's shadow, she is exactly in her node, or has no latitude when she comes to her opposition. When she is about 6° from her node, at the time of opposition, she will pass through the earth's shadow, and be totally eclipsed in it. When she is full at 12° from her node, she just touches the earth's shadow, but without entering it.

When therefore, an eclipse of the moon is both total and central, its duration is the longest possible, namely, about 3h. 57m. 6s. from the beginning to the end, when the moon is in apogee, or at the greatest distance from the earth, and about 3h. 37m. 26s. when she is in perigee, or nearest to it.

In estimating the quantity of an eclipse, either of the sun or moon, the disc of the eclipsed body is supposed to be divided into 12 equal parts, called digits, and so many of these parts as are obscured, so many digits is the sun or moon said to be eclipsed.

When the moon is said to be any number of digits eclipsed above 12, it is understood that she is wholly immersed in the earth's shadow, which extends so many digits beyond her limb, as the number of digits she is said to be eclipsed exceeds 12.

The term degrees is now sometimes substituted for digits, each degree being subdivided into 60 equal parts, called minutes, and thus the quantity of an eclipse is frequently expressed in degrees and minutes.

The number of eclipses in any year cannot be less than two, nor more than seven, in the former case they will be both solar, and in the latter there will be five solar and two lunar, which last will be both total. There are sometimes six; but the more usual number is four, two of the sun, and two of the moon.

These varieties may be thus accounted for;—although the sun usually passes by both the nodes only once a year, making four eclipses, yet if he pass by one of the nodes about the beginning of the year, he may pass the same node again a little before the end of the same year; because, by reason of the retrograde motion of the moon's nodes, the sun will come to either of them 173 days after the other: he may therefore return to the same node in about 346 days, thereby making six eclipses.

Again, since twelve synodical revolutions, or 354 days from the eclipse in the beginning of the year, may produce a new moon before the conclusion of it, and since this new moon may fall within the solar limit, it is possible for seven eclipses to happen within the year.

When the moon changes in either of her nodes, she cannot come within the lunar limit at the next full, and therefore cannot be eclipsed, and in six lunar months afterwards, she will change near the other node.

In this case there cannot be more than two eclipses in the year, and both of the sun. Although the ecliptic limits of the sun being greater than those of the moon, solar eclipses are more frequent than lunar ones, yet we have more *visible* eclipses of the moon than of the sun; because the former are visible from all parts of that hemisphere of the earth which is turned towards the moon; but the latter are only seen from that small portion of the hemisphere next the sun, whereon the moon's shadow falls.

The mean motion of the lunar nodes being about 19° 19′ 43″ yearly, they perform a complete revolution in the ecliptic in about 18 years, 244 days; this period however, comprising no complete number of lunations, cannot become a regular period of eclipses.

But in 223 lunations, of 18 years, 11 days, 7h. 42m. 31s. when leap year is four times included, or a day less when it occurs five times in that period, we shall have the mean time of the return of the same eclipse (that is, of the middle time of it) tolerably near the truth.

A period however, much more exact than the preceding, (commonly called the Chaldaic period,) consists of 6890 or 557 Julian years, 21 days, 18h. 4m. 47s. at the end of which time, the moon's distance from the position she had relatively to the sun and earth at the beginning of this period, will not exceed one minute, four seconds, and a period still more exact is that of 2362 years, 16 days, 5 hours, 5 minutes.

OF THE FIXED STARS.

The *permanence* of the relative situation of the fixed stars on the celestial sphere, peculiarly adapts them for marks or celestial stations, to which the *erratic* bodies may be continually referred, in tracing their respective motions through the heavens; they also furnish means of determining with precision the place of a ship at sea,—the local situation of particular stations on the earth's surface,—and many other important geographical facts.

To the mariner, therefore, in particular, (who in pursuing his voyage through the vast and trackless ocean, should omit no opportunity of ascertaining the ship's place by celestial observation) a tolerable proficiency in this branch of astronomy is indispensable.

When we take a casual survey of the heavens, on a clear winter's evening, in the absence of the moon, we are apt to conceive that the number of stars presented to our view exceeds all calculation, yet it is probable that under the most favourable circumstances not more than two thousand, visible to the naked eye, are at any one time above the horizon; and that the whole number of stars which may be so seen, does not exceed three thousand five hundred.

Of these some are much more brilliant, and appear larger than others, and this difference in the apparent size and splendour of the stars, may arise either from a diversity in their real magnitudes and brightness, or (which is more likely) from their being placed at unequal distances from us; although, in some instances, these causes may all combine to produce this difference of appearance, which difference is, indeed, so obvious as to have given rise to an arrangement of those stars that may be seen without the application of the telescope, into classes or orders, called magnitudes.

The brightest and largest are said to be of the *first* magnitude, the next in lustre are called stars of the *second* magnitude, and so on to the *sixth*, which are the smallest that can be perceived by the naked eye. The decreasing scale is also continued by the assistance of very powerful telescopes, down to the sixteenth magnitude; all those, however, below the sixth, have the general denomination of *telescopic stars*.

Very few of the stars of any one of these classes are exactly of the same size and brightness, hence it happens that many of those which are by some astronomers considered of the first magnitude, are by others assigned to the second; and the same uncertainty exists with regard to the other classes.

In order to facilitate the description of the heavens, and the reference to any particular star, the ancients reduced this numerous class of bodies into a number of groups, or assemblages of neighbouring stars, which they called *constellations*, and to each of these constellations they gave the name of some sensible object, to which they fancied they discovered a general resemblance in the disposition of the stars that composed the constellation.

It was not, however, to the constellations only, that the ancients gave particular names, smaller collections of stars, and some of the most remarkable single stars, were distinguished in the same manner, but the best method of marking the individual stars, in each constellation, is that introduced by Bayer, about the year 1603, and consists in applying the letters of the Greek and Roman alphabets, in such a manner, that the principal star of every constellation, is denoted by the first letter of the Greek alphabet; the next brightest, by the second letter, and so on.

It is however, to be remarked, that the Greek letters do not indicate the *real* magnitudes of the stars, to which they are applied, but only the *relative* magnitudes of those in the *same* constellation. When any constellation contains more stars than the Greek alphabet extends to, the letters of the Roman alphabet, are employed in like manner to supply the deficiency, and succeeding astronomers, have further extended this useful method of particularizing individual stars, by adding the ordinal numbers 1, 2, 3, &c. in the same regular succession, when any constellation contains more stars than can be marked by the two alphabets.

The ancient constellations (as they are now called,) were forty-eight in number, or fifty, including Antinöus, and Coma Berenices, and were for the most part so delineated, as to bring the principal stars into the most conspicuous parts of the figures, they were supposed to represent; but as in this distribution of the stars, many of them from their peculiar situation in the heavens, could not be comprehended in any of those figures, the stars so left out were called *unformed stars;* most of these have been since reduced into new figures by modern astronomers, so that the number of constellations into which the heavens are at present divided, exceeds a hundred, and it is probable that others will yet be invented.*

In tracing the apparent annual motion of the sun through the heavens, we shall find that he always describes one great circle of the sphere, from which he never deviates. This circle, κυκλος ηλιακος passes through twelve of the ancient constellations, and these which were originally but eleven in number, (and then according to the Chaldean division, consisted entirely of animal figures,) obtained the name of the constellations of the *zodiac,* which term, zodiac, is still applied to a zone in the heavens, extending about eight degrees on each side of the *ecliptic,* so called because eclipses can only happen, when the moon is either in or very near to that circle.

These constellations derive their chief interest to the astronomer, from their having given names to the twelve equal parts, (called signs) of 30° each, into which the ecliptic is divided. Those constellations which are north of the ecliptic are called *northern,* and those which are south of that circle, *southern constellations,* and since the ecliptic is inclined 23° 28′, to the equinoctial or celestial equator, instances occur of northern constellations having south declination, and *vice versa,* a circumstance which demands the student's particular attention.

Table 12, (page 135,) gives the names of the principal constellations and the chief stars in each, with their magnitudes, right ascensions declinations, &c. and Table 20, page 143, contains the apparent time of the meridian passage of the principal fixed stars on the first day of the month.

The whole number of stars, visible in the absence of the moon, and in the most favorable state of the atmosphere, does not exceed 3500; by the aid of the telescope indeed, we discover myriads of stars, which were inaccessible to the naked eye, and as we increase the power of the instru-

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* For a better knowledge of the Constellations and the Fixed Stars in general made use of in Navigation, reference must be made to the "PLANISPHERE OF THE STARS, with Directions to find their positions in the heavens, with respect to each other," which I have published for the use of the Navigator.

ment, more and more of these bodies are brought into view, so that their numbers may without impropriety be deemed infinite.

More than 2000 stars have been observed in the constellation Orion, and upwards of 188 in the Pleiades. Galileo found 80 in the belt of Orion's sword, 21 in the nebulous star in his head, and about 500 within the space of one or two degrees, in another part of the constellation.

The same observer also counted more than 40 in the luminous spot in the constellation Cancer, called *Præsepe* or the bee-hive, and in a portion of the milky-way, (which is nothing but an assemblage of stars, too remote to be seen separately, but so closely disposed as to give a luminous appearance to that part of the heavens in which they are situated,) Dr. Herschel observed the surprising number of 116,000 stars, pass through the field of view of his telescope, in one quarter of an hour's time.

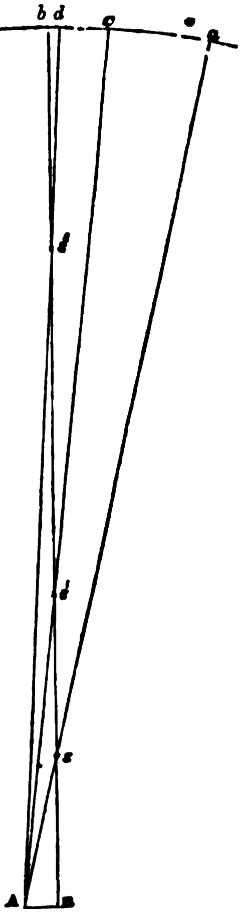
In endeavouring to determine our own particular situation, with respect to surrounding objects, and more particularly when these objects, although within our field of view, are extremely remote, the first question that naturally suggests itself, is how far distant those objects are from us, and this is one of those enquiries which may in general, be answered with numerical precision, if not by simple and direct measurement, at least, by the application of geometrical principles; with respect however, to the fixed stars, this is far from being the case; every attempt that has hitherto been made to discover the annual parallax of these bodies, in order to determine their distance, only tending to prove, that the diameter of the earth's orbit, in length 190,000,000 miles, does not subtend a sensible parallax, at the nearest fixed star that has been observed for this purpose, yet such is the nicety to which these observations have been carried, that did the parallax or angular difference in the apparent place of the star, as viewed from the opposite extremities of this enormous base, amount to a single second, it could not possibly have escaped detection.

Parallax, in its most simple form, may be defined the angular distance between the apparent places of a remote object, viewed from two different stations, and it is always equal to the angle which a line, joining these stations, subtends at the object.

This phenomenon arises from our constantly referring the position of any distant object, to the surface of an imaginary sphere of an indefinite radius, having our eye for its centre.

To illustrate this subject, let A and B, in the marginal figure, be two stations from which we view the object *s*.

At B the object is referred to the point *b*, in the imaginary sphere. by the visual line B*sb*; and at A, it is in like manner referred to the point *a*. this apparent angular change of place in the object, arising from our change of position, is called the *parallax*, and is expressed by



the angle *asb*, which is equal to the angle ASB, subtended at the object *s*, by a line joining the stations A and B.

Now it is obvious, from the figure, that the parallax decreases, as the distance of the object increases; for if the object be removed to *s′*, the parallactic angle is *bs′c*, and at *s″* it is only *bs″d*; when therefore, as is the case with the fixed stars, the distance of the object becomes *extremely great*, in comparison of the distance between the stations from which it is observed, the parallax becomes insensible, that is, the place of the object remains unchanged.

But although we cannot determine the true distance of the nearest fixed star, yet limits may be assigned, beyond which it must be placed, and we accordingly do know that it cannot be less than 20,000,000,000 miles from us.*

The distance of the stars being unknown, we can only form conjectures respecting their real magnitudes, or intrinsic splendour, and in these enquiries no direct information is to be gained from the telescope, since the fixed stars, even when examined by very good instruments of this kind, have no apparent diameter, but appear only like brilliant points in the heavens.

From experiments hitherto made upon the light emitted by some of these bodies, it is probable that none of them are inferior, and that the major part of them are superior to our sun in magnitude.

It has been already observed, that the earth is flattened at the poles, and swelled out at the equator, whence it assumes the form of an oblate spheroid. By the joint action of the sun and moon, upon the protuberant parts of this spheriod, or the equatorial regions of the earth, a phenomenon is produced, called the Precession of the Equinoxes, being a slow and almost imperceptible motion, by which the equinoxes change their places, going backwards, or westward on the ecliptic, contrary to the order of the signs, at the rate of about 50¼ seconds in a year, in consequence of which precession, the longitude of all the stars (being reckoned from the first point of Aries,) will increase 50¼ seconds every year.

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* The parallax here spoken of must not be confounded with the *diurnal parallax*, or *parallax in altitude*, hereafter to be described.

By this retrogradation of the equinoctial points, the signs of the ecliptic, which in the time of Hipparchus, (by whom this phenomenon was discovered) corresponded with the constellations after which they are named, have moved backwards about 30 degrees; they, however, still retain their ancient names, notwithstanding their having shifted their places, with regard to their constellations, one whole sign; thus the first sign, or first of the twelve equal portions into which the ecliptic is divided is still called Aries, although it now corresponds to the constellation of the Fishes; the second sign is called Taurus, though in the constellation Aries, and so on.

The variation in the right ascension and declination of the stars, given in Table 12, is also attributable to the same cause. The equinoctial points make a complete revolution in something less than 26,000 years, the poles of which, consequently, describe a circle round the poles of the ecliptic, whose diameter is about 47 degrees, being equal to twice the inclination of the ecliptic to the equator.

The annual precession being as above described, it is evident, that if the sun set out from one of the equinoctial points, he will, in describing his apparent annual revolution, arrive at the same equinoctial point again something before he has performed a complete revolution in the heavens; for the equinoctial point from which he set out, has, as it were, retreated 50¼ seconds to meet the sun, hence the sun's arrival at that point *precedes* his arrival at the same fixed spot in the heavens, from which he started the year before, by 20′ 23″ of time, or by an arc of 50¼ seconds. This revolution of the sun from an equinox to the same again, is called a *tropical* or *solar* year, and is that upon which the seasons depend.

The time in which the sun revolves from any fixed star to the same fixed star again, is called a sidereal year, and is the true time in which he performs a complete revolution in the heavens; the difference therefore between a tropical and sidereal year is 20 minutes 23 seconds, the former being performed in 365d. 5h. 48m. 49s. and the latter in 365d. 6h. 9m. 12s.

It has been remarked that the precession of the equinoxes, is caused by the joint action of the sun and moon, upon the equatorial regions of our earth. In producing this phenomenon, the effect of the moon greatly exceeds that of the sun; for although the magnitude of the sun so far surpasses that of the moon, yet the proximity of the latter, more than compensates for the excess of magnitude in the former, and it is found, that of the whole precession, very little more than 15s. is produced by the attraction of the sun, while that of the moon exceeds 35s.; there is, however, an inequality in the part of the precession produced by the action of the moon, caused by the perpetual change in the position of her nodes, and the inclination of her orbit to the earth's equator.

To these causes, also, is to be principally attributed an apparent motion in the fixed stars, resulting from a real motion of the earth's axis, called its nutation. By this motion it describes from east to west a small ellipse in the heavens, whose diameters are 19·1 seconds, and 14·2 seconds, and its period, which corresponds to that of the revolution of the moon's nodes, is 18 years. One of the most important effects of this nutation, is the change produced by it, together with the precession of the equinoxes, in the obliquity of the ecliptic, which change is computed for different times of the year, and set down in the ephemeris.

The orbits of all the other planets being inclined to the earth's equator, the action of those bodies upon the protuberant matter about the equatorial regions, must also have a tendency to diminish the obliquity of the ecliptic, and also to produce a precession in the equinoctial points. Their effects, however, are almost insensible: the diminution of the obliquity, arising from the united action of all the planets, not exceeding 50 seconds in a century, and the corresponding precession amounts only to 18½ seconds.

COMETS,

are distinguished from the Planets by their dull and cloudy appearance, —their rapid and seemingly irregular motions,—the long train of light which frequently accompanies them,—and by their being found in every part of the firmament; they may be considered a distinct species of bodies quite unconnected with the object of this Treatise.

ASTRONOMICAL DEFINITIONS.

It being of great importance that the pupil should properly understand the Astronomical terms made use of in the following pages, before proceeding to the explanation or solution of the methods for determining the place of a ship at sea, by celestial observations, the following Definitions are introduced for the purpose of giving a clearer insight into a knowledge of the science.

The *celestial sphere* is that vast apparent concave, in which the heavenly bodies seem to be situated.

Celestial meridians are semicircles passing through the pole of the heavens.

The planes of all the *great* circles of the celestial sphere, form, by their intersections with the surface of the earth, corresponding *great* circles on the latter.

This transference of the circles from one sphere to the other, may, however, be sometimes more clearly understood, by conceiving the planes of great circles on the earth to be extended to the sphere of the heavens; but the most perfect notion of the mutual reference of the circles of one sphere to the other, may be obtained by imagining the celestial sphere to be uniformly contracted in its dimensions, without any change in the relative position of its parts, till it be just sufficient to inclose the terrestrial sphere, by which method the small as well as the great circles of the heavens, may be transferred to the same positions on the earth, retaining, however, their proper or individual names; thus, those circles which in the celestial sphere are *parallels of declination*, north and south of the equinoctial, become *parallels of latitude* on the earth, at corresponding distances from the equator, &c.

The *axis* of the celestial sphere is an imaginary line passing through the centre of the earth, and produced to the heavens; about which line all the heavenly bodies appear to have a diurnal revolution.*

The *poles* of the celestial sphere are the extremities of its axis, the one being called the north, and the other the south pole.

The *equinoctial* is a great circle coincident with the terrestrial equator, and dividing the heavens into two hemispheres the northern and southern, it is called the equinoctial, because, when the sun appears in it, the days and nights are of an equal length all over the world, viz. 12 hours each. This happens twice in the year, about the 21st of March, and the 23rd of September, the former is called the *vernal*, and the latter the *autumnal* equinox.

The *ecliptic* is that great circle in which the annual revolution of the earth round the sun is performed. It is so named, because eclipses cannot happen, but when the moon is in or near that circle. (*see* Eclipses, page 136.

It cuts the equinoctial in an angle of 23° 28′ which is called the *obliquity of the ecliptic*. The ecliptic is divided into twelve equal parts, of 30° each, called signs, which are named after certain constellations in the heavens, through which the ecliptic itself passes.

Their names and characters are as follows:

♈ Aries
♉ Taurus
♊ Gemini
♋ Cancer
♌ Leo
♍ Virgo
♎ Libra
♏ Scorpio
♐ Sagittarius
♑ Capricornus
♒ Aquarius
♓ Pisces

The first six signs lie on the north of the equinoctial, and are called the *northern signs*, the last six lying on the south are called *southern signs*.

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* Although the earth's real motion, from west to east, on its axis, is the cause of day and night, and of the apparent diurnal motion of all the heavenly bodies from east to west, and although, also, the earth's annual revolution about the sun, is the cause of the vicissitudes of the seasons, yet as all the phenomena resulting from these motions will be the same whether the earth moves and the celestial sphere be at rest, or vice versa, we shall, whenever we find it most convenient so to do, speak of the earth as being at rest, in the centre of the celestial sphere, and ascribe to the heavenly bodies those motions, which they appear to have to a spectator on the surface of the earth.

The term *signs* is, by authors in general, applied to the *zodiac*, as well as to the ecliptic; since, however, the signs of the ecliptic no longer coincide with the constellations, from which their names are derived, it would be well to drop the term *signs of the zodiac*, commonly used synonymously with *signs of the ecliptic*, and always to substitute the word *constellations*, when referring to the former.

The signs of the ecliptic are entirely *anastrous*, having no corresponding stars, they are also of equal extent, each containing 30°, while the zodiacal signs, as they are erroneously called, are composed entirely of constellations, occupying spaces of very unequal dimensions,—great confusion to learners would be thus avoided. The latter circle, or rather zone of the celestial sphere, will be described in treating of the *Fixed Stars*.

The *poles of the earth* are the extremities of the axis or line on which the earth revolves, and are called north and south poles.

By the *elevation of the pole* is meant the altitude of the pole above the horizon, or an arc of the meridian intercepted between the pole and the horizon, and is equal to the latitude of the place, as will be seen in the figure, at the commencement of the Methods for finding the Latitude.

The *colures* are two great circles, imagined to intersect each other at right angles in the poles of the world; viz.

The *equinoctial colure* which passes through the poles and the equinoctial points, and

The *solstitial colure* which passes through the poles and the solstitial points, Cancer and Capricorn.

The beginning of the sign Cancer, and the beginning of the sign Capricorn, are called *solstitial points*, because when the sun is near them his altitude at noon does not sensibly vary for several days together, he therefore appears to stand still or stop. The former is called the *summer solstice*, being the most northernly point, or declination, the sun ever attains: and the latter is called the *winter solstice*, because at that time he arrives at his most southernly point. But this distinction is to be understood as applicable only to the northern hemisphere, for in the southern, the sun's entrance into Capricorn makes the summer solstice, and that into Cancer the winter solstice.

The *equinoctial points* are the two opposite points where the ecliptic intersects the equator or equinoctial; that at which the sun crosses from the south to the north side of the plane of the equator, is called the first point of Aries, or the *vernal* equinox, opposite to which is the beginning of the sign Libra, or the *autumnal* equinox.

The tropics are two circles, parallel to the equinoctial, which the sun, appears to describe when he arrives at the solstitial points, they are so called, because, after describing either of these circles, he appears to turn back towards the equinoctial; that tropic which cuts the beginning of the sign Cancer, is called the *tropic of Cancer*, and the other the *tropic of Capricorn.*

The *arctic circle* is a small circle parallel to the equinoctial, at the distance of 23° 28′ from the north pole, or 66° 32′ from the equinoctial.

The *antartic circle* is a similar circle, at the same distance from the south pole, as the arctic circle is from the north.

The *latitude* of a star or planet is its angular distance from the ecliptic northwards or southwards, reckoned in degrees, minutes, and seconds, on a circle of longitude, or circle intersecting the ecliptic at right angles, and consequently passing through its poles.

The *longitude* of a heavenly body is its distance eastward, reckoned on the ecliptic, from the point Aries, or that intersection of the ecliptic and equinoctial, from which the former ascends north of the latter. Celestial longitude is estimated in degrees, minutes, and seconds, from 0 to 360°, or in signs of 30° each, from 0 to 12 signs.

The *declination* of any celestial object, is its angular distance from the equinoctial, northward or southward.

Parallels of declination are circles parallel to the equinoctial.

The *right ascension* of any celestial body, is its distance from the point Aries, reckoned on the equinoctial, either in degrees, minutes, &c. from 0 to 360°, or in hours, minutes, and seconds, from 0 to 24 hours.

The *nodes* are the points in which the plane of any planet's orbit, or path, intersects the plane of the ecliptic. That point from which the planet ascends from the south towards the north of the ecliptic, is called its ascending node, and is thus marked ☊, the other is called the south or descending node, and is thus marked ☋.

The *zenith* is the vertical point or that point in the heavens immediately over the head of the observer.

The *nadir* is the point of the heavens directly under his feet. The *zenith and nadir* are at the same angular distance from the celestial equator, that the observer is from the terrestrial one.

The *zenith* and *nadir* are the poles of the horizon.

The *zenith distance* of any object is its angular distance from the zenith, and is the complement of the altitude to 90°.

The *visible* or *apparent* horizon, is that circle which bounds the sight of the spectator on all sides, where the earth and sky appear to meet, and is of greater or less extent according as the eye is nearer to, or more remote from the level of the earth; it divides the sphere into two unequal parts.

The *sensible horizon* is a plane passing through the eye of an observer, perpendicular to a plumb line hanging freely, its poles are the zenith and nadir. Altitudes taken on shore, are measured from the sensible horizon.

The *rational* or *true* horizon, is a plane passing through the centre of the earth, parallel to the *sensible horizon,* dividing the sphere into two equal parts, that which is above the horizon being called the *visible* and that below the horizon the *invisible* hemisphere.

The *sensible* and *rational* horizon, though distant from each other by the semidiameter of the earth, will appear to coincide, when continued to the sphere of the fixed stars, because the earth, compared with this sphere is but a spot.

The *dip of the horizon* is the angle contained between the sensible and apparent horizons, the angular point being the eye of the observer.

Vertical circles, called also *circles of azimuth,* are great circles of the sphere, passing through the zenith and nadir; they are therefore perpendicular to the horizon.

The *prime vertical* is a circle at right angles to the meridian, and meets the horizon in the east and west points. When an object is on the *prime vertical* its azimuth is 90°.

The *meridian* of any place is a semicircle passing through that place, and terminating at the poles of the equator, the other half of this circle is called the *opposite meridian.* The *first* meridian is an imaginary semicircle passing through any remarkable place. The English reckoning that circle their first meridian, which passes through the Observatory at Greenwich.

The *altitude* of any celestial object, is its height above the horizon, measured on a vertical circle.

Parallels of altitude are circles parallel to the horizon.

The *meridian altitude* is the distance of an object from the horizon, when on the meridian of the place of observation, and will evidently be the greatest altitude the object can have.

The *altitude of a celestial object* as seen from the surface of the earth, is called the *apparent* altitude, but as seen from the centre the *true* altitude.

The *semidiameter* of an object is half the angle subtended by the diameter of the visible disc.

Augmentation. Since the moon is nearer to an observer on the earth, when she is in the zenith than when in the horizon, by the earth's semidiameter, she must therefore increase her semidiameter, as she increases her altitude from the horizon to the zenith, this increase is called the *augmentation of the moon's semidiameter.*

The *azimuth* of a body is the arc of the horizon intercepted between the vertical circle and the meridian, or, it is the angle at the zenith, formed by the meridian and the vertical circle passing through the object, and may be measured either from the north or south.

The *amplitude* of any object is the arc of the horizon between the object at its rising or setting, and the east or west point of the horizon, and is named eastern or western amplitude accordingly, and is the complement of the azimuth.

Hour circles are the same as the meridians, being great circles which pass through the poles of the earth, perpendicular to the equator.

The *hour angle* or *horary angle* is the angle at the pole, contained between the meridian of the place of observation and the circle passing through the object, and is measured on the equinoctial or celestial equator, in the same way that longitude is measured on the terrestrial equator, being converted into time at the rate of 15° to an hour.

Equation of time is the difference between *equal* or *mean* time as shewn by a well regulated clock or watch, and *apparent* time as shewn by a sun-dial; or the difference between the *true* and *mean* sun, and depends on the obliquity of the ecliptic, combined with the unequal motion of the earth in her orbit.

Sidereal time begins when the first point of Aries is on the meridian, and is counted through 24 hours, until the same point is again there.

A *sidereal year* is that space of time which the sun takes in moving through the ecliptic, from any fixed star to the same fixed star again.

The *sidereal time at mean noon,* is the right ascension of the meridian at the instant the sun, if he moved uniformly, would be on it: in other words, it is the angular distance of the first point of Aries from the meridian, at the instant of mean noon; it is therefore the right ascension of the mean sun or the time which ought to be shewn by a sidereal clock at Greenwich, when the mean time clock shows 0h. 0m. 0s.

A *sidereal day* is the time between two successive transits of a star over the same meridian, it is divided into sidereal hours, minutes and seconds, and is a mode of reckoning, much used by astronomers in determining the right ascension of the heavenly bodies.

The distance of the fixed stars is so immensely great, that in comparison of it, the orbit in which the earth revolves round the sun, sinks into a mere physical point, in consequence of which, and the uniformity of the earth's motion on its axis, any given meridian revolves from any fixed star, to the same star again, in the exact time that the earth completes a rotation on its axis; viz. 23h. 56m. 3·4s. and this would likewise be the case with regard to the sun, if the earth had only a diurnal without an annual motion, but as the earth, while turning once round its axis, advances almost a degree eastward in its orbit, if the sun be on the meridian of any place on a certain day, the earth must perform something more than a complete rotation, in order to bring the same meridian under the sun on the day following; in other words, the earth, in order to bring the same meridian round from the sun to the sun again, must perform one complete rotation on its axis, and as much in proportion of another rotation as it has advanced in its orbit during that time, namely, about one 365th. part at a mean rate, consequently in 365 days the earth must perform 366 rotations, and since each rotation completes a *sidereal day*, there must be 366 sidereal days in a year; or, in more general terms, since a rotation of any planet about its axis, is the length of a sidereal day to that planet, the number of sidereal days will always exceed the number of solar days by *one*, let that number be what it may, one rotation being always lost in the course of an annual revolution, by the planets going round the sun.

A *sidereal clock* represents the rotation of the earth on its axis, as referred to the stars; its hour hand performing a complete revolution through the 24 hours, in the interval between the departure of any meridian from a star, to its next return to it.

The *hour angle of the first point of Aries* is the right ascension of the meridian.

An *apparent* or *solar* day is the time between the sun's leaving the meridian of a place and his arrival at the same meridian again.

A *mean natural, or solar day*. The earth's motion about its axis being perfectly uniform, the sidereal days are always of the same length, but the *solar* or *natural* days vary considerably at different times of the year, and in order to obviate this inconvenience, recourse is had to a *mean solar day*, the length of which is equal to the mean of all the apparent solar days in a year, and is such as would be shown by the sun if the earth revolved with an equable motion in a circular orbit round the sun, and had at the same time its axis perpendicular to the plane of its orbit; this not being the case, the time shown by a clock, which always shows mean time, and that shown by a true sun dial is seldom the same, the difference being, as before explained, the *equation of time* or equation of *natural days*. This difference is set down in pages I and II of each month in the Nautical Almanac; to reduce *apparent* to *mean* time, the equation is to be taken from page I of the month, but to reduce *mean* to *apparent* time it is taken from page II, in each case to be applied as directed at the top of the respective column.

A *mean solar day* consists of 24 hours, and is either civil or astronomical.

A *solar or tropical year* is the interval of time between two successive returns of the sun to the same equinoctial or solstitial point.

An *anomalistic year* is the interval of time between two successive returns of the earth to the same apsis.

The *civil day* or that which is applied to the civil purposes of life, begins and ends at midnight, it is divided into twice 12 hours, the first 12 hours of the civil day, from midnight to the noon following, are said to be A.M. (ante meridiem,) the last 12 hours, that is, the 12 hours between noon and the following midnight, are called P.M. (post meridiem.)

The *astronomical day* commences at the noon of the civil day of the same date, and ends at the following noon, the hours being reckoned from 0 at noon up to 24, without any distinction of A.M. and P.M. when therefore, the given civil time is in the afternoon, (or P.M.) it answers to the astronomical day of the same date, but when the given civil time is before noon (or A.M.) we must add 12h. to it, to convert it into astronomical time, which will be of the day of the month preceding the given civil day; thus 6h. 15m. P.M. civil time of the 4th of April, is 6h. 15m. astronomical time of the same date; but 6h. 15m A.M. civil time on the 4th of April, is 18h. 15m. *astronomical time* on the 3rd of April.

The *nautical day* ends at the instant that the astronomical day of the same date begins; nautical time therefore, is always 24 hours in advance of astronomical time, to convert it into which, we have only to reckon the hours from the preceding noon, and to change the day of the month to that preceding the given day; thus, 6h. 15m. P.M. nautical time on April the 4th, is 6h. 15m. P.M. astronomical time on the 3rd of April; and 6h. 15m. A.M. on the 4th of April, nautical time, is 18h. 15m. on the 3rd of April, astronomical time.

Hence it appears that the same noon answers for any given day, in all the three methods of reckoning; the noon of the astronomical day being the instant that it begins, that of the nautical day the instant when it ends, and both taking place at the noon of the civil day of the same date.

The *artificial day*, at any place, is the time of the sun's continuance above the horizon of that place. If the earth's axis were perpendicular to the plane of its orbit, the artificial day would always be very nearly of the same length. The earth's axis however, is declined 23° 28′ from the perpendicular, or, which is the same thing, it is inclined 66° 32′ to the plane of the ecliptic; on which account, and its always continuing parallel to itself, during the whole of the earth's annual revolution round the sun, the artificial day is perpetually varying. Thus, on the 21st of June, the north pole inclines towards the sun, by which inclination of the earth's axis, the sun, at this season of the year, is 23° 28′ above the terrestrial equator; and as he enlightens only one half of the earth at a time, the north pole will be illuminated, and this illumination will extend 23° 28′ beyond the pole, to the most distant part of the arctic circle, the whole of which, during the earth's diurnal rotation, will enjoy perpetual day; while for the same reason, those parts of the earth comprehended within the antarctic circle, will be involved in total darkness.

Those regions of the earth which lie between the arctic circle and the equator, will, during a part of the earth's diurnal revolution be carried into the dark hemisphere, but as they will continue during a longer period in the enlightened hemisphere, the day will be longer than the night. At the equator, the day and night will be exactly of an equal length all the year round.

On the 21st of December, the earth being in the opposite point of its orbit, and the north pole declining from the sun, the reverse of this takes place; the whole of the arctic circle is involved in darkness, while the antarctic circle is entirely illuminated. Those places which lie between the arctic circle and the equator have the night longer than the day; while those which lie between the equator and the antarctic circle have the day longer than the night.

On the 20th of March, and the 23rd of September, the earth's axis inclines neither to nor from the sun, which being vertical to the equator makes equal day and night at all places on the earth's surface.

In the description of the seasons, no notice has been taken of any inequalities in the annual motion of the earth round the sun, or which is the same thing, in the apparent motion of the sun round the earth. If however, we carefully note the time at which the sun is in the equinoxes, we shall find that he is about eight days longer on the north side of the equinoctial, than on the south side of it; or, that the days of the equinoxes divide the year into two unequal parts; in other words, that the sun appears to take about eight days more to move from the vernal to the autumnal equinox, than he does to pass from the autumnal to the vernal.

This difference (the spaces passed through by the sun being in both cases alike,) arises from the real motion of the earth, or which is the same thing, the apparent motion of the sun being greatest about the beginning of January, and slowest about the beginning of July, and his apparent magnitude increasing and decreasing with the velocity of his motion,* proves that the earth revolves in an elliptic orbit about the sun placed in one of the foci of the ellipse, and also that the earth is in perihelion, about the beginning of January, and in aphelion, about the beginning of July, or as it is more commonly expressed, that the sun is in perigee, at the former, and in apogee, at the latter time.

To explain the nature of Refraction, the following account of the Atmosphere, will be necessary as well as interesting.

The earth is surrounded on all sides by a body of air, extending to a very considerable height above its surface, and supporting a heterogeneous collection of aqueous and other vapours and exhalations, from which circumstance, combined with its spherical shape, it is denominated the atmosphere.

Now the atmosphere, in common with all other material substances, is endued with weight and pressure, though in an inferior degree to most other bodies with which we are acquainted; by repeated experiments, it is found that the pressure of the atmosphere sustains a body of quicksilver in the tube of the barometer, of about 29½ inches in height, and of an equal base, and because 29½ cubic inches of quicksilver are found to weigh about fifteen pounds, therefore the weight of the atmosphere on every square inch of the earth's surface is equal to about that weight.

The atmosphere is of an elastic or springy nature, and when compressed by different weights, is found, by repeated experiments, to occupy spaces reciprocally proportional to those weights, or that the more the air is pressed, the less space it occupies.

It follows, therefore, that the lowest parts of the atmosphere must be the heaviest, as well as the most dense, being pressed upon by the weight of all the atmosphere above them, and consequently, that the air in the upper regions of the atmosphere, must become continually more and more rare, as it ascends higher above the earth's surface, and this is the reason why clouds and vapours can only rise to a certain height, for where the air, in the higher regions of the atmosphere, becomes specifically lighter than the clouds themselves, it will of course be unable to sustain them: the greatest height at which visible clouds ever exist, does not probably exceed ten miles, and even at two miles above the earth's surface, the atmosphere is seldom dense enough to support them.

The barometer affords a direct measure of the rate of diminution of the quantity of air which a given space includes, as we recede in a perpendicular direction from the earth's surface; from the indications of this useful instrument we learn, that when we have attained the elevation of 1000 feet, we have left below us about one-thirtieth of the whole mass of the atmosphere; that at 10,600 feet of perpendicular height we have ascended through one-third, and at 18,000 feet, through one-half of the *ponderable* body of air, incumbent on the earth's surface.

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* The sun's semi-diameter for every day in each month, is set down in page II of the month in the Nautical Almanac, when however, great accuracy is not required, the mean semi-diameter 16′ is commonly used, as it never deviates 30″ from that quantity.

From the progression of these numbers we may readily infer, that although by rising still higher, we should continually surmount more and more of the air, yet the ponderable quantity of air passed through, would not be in proportion to the additional height ascended, but in a constantly decreasing ratio.

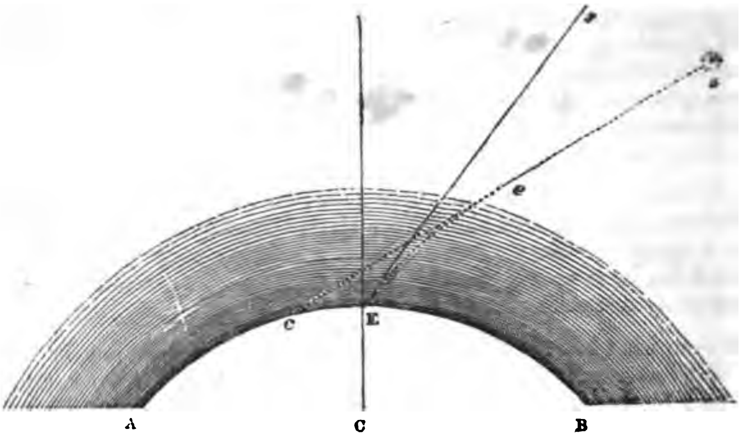
From what has now been said, the atmosphere may not be inaptly considered as an aërial ocean spread over the surface of our earth, and which, from its extreme subtilty and elasticity, is peculiarly susceptible of the smallest motion any disturbing force may be supposed capable of exciting, hence tides will be generated in the atmosphere, similar to those in the ocean, the same causes operating to produce corresponding effects in both.

The air also, like the sea, is preserved in a healthful state by its continual motion, which however is productive of similar terrific consequences in both, when too suddenly or too powerfully excited.

The atmosphere is also the vast theatre in which all those surprising phenomena, known by the general name of meteors, is exhibited; it is however the power which it possesses, in common with all transparent media, of refracting the rays of light, or bending them out of their rectilinear course, that renders a knowledge of the constitution of the atmosphere peculiarly essential to the astronomer.

This property causes all objects, seen obliquely through it, to appear otherwise situated than they would be as viewed from the same point, had the atmosphere either no existence, or not possessed this property. In order, therefore, to obtain by observation the true place of any heavenly body, it is necessary to ascertain, what change the light emitted by that body undergoes, in passing through this immense refracting medium, and to determine in what direction, and to what extent, our observations are affected by this change.

Now it is an established and well known law of optics, that a ray of light, in passing obliquely from a more dense to a rarer medium, is refracted or bent downwards, or towards a perpendicular, since, therefore, the atmosphere consists, as shown in the figure on the next page, (in which AEB represents a portion of the earth's surface covered by the atmosphere,) of a medium whose density continually decreases, as we recede from the earth's surface, a ray of light *se*, proceeding from a star or other luminous body at S, upon entering the atmosphere at *e*, instead of pursuing its rectilinear course *ec*, and striking the earth at *c* will be deflected into a curve, continually more and more concave, towards the earth's surface, and will actually reach the earth at E, the place of the spectator.



Now it is a well-known law in optics, that any object is seen in the direction in which the ray emitted by it, enters the eye of the spectator, the star s therefore will not be seen at s, its true place, but will appear at *s*, in the direction of the tangent to the curve *e*E, at the point E, with which the last elementary portion of the curve will of course coincide. Hence it is obvious the effect of refraction is to increase the apparent altitude of any celestial body.

Now the more obliquely a ray of light enters a refracting medium, the greater will be the refraction; and as a ray of light from an object in the horizon enters the atmosphere more obliquely than when the object has any altitude above it, it follows that the horizontal refraction must be the greatest. This at a mean state of the atmosphere, amounts to no less than 33′ which being rather more than the greatest apparent diameter of either the sun or moon, causes those bodies to appear just above the horizon, when they are really below it.

As the altitude of the object increases, the refraction rapidly diminishes; thus, the average amount of refraction for an object at an apparent altitude of 45° or halfway between the horizon and the zenith is but about 57″, and when the object is in the zenith or point immediately over-head, the rays of light entering the atmosphere in a perpendicular direction, there is no refraction.

From the same cause it is, that the sun or moon when near the horizon assumes an oval figure, its horizontal diameter being visibly greater than the vertical, and when in immediate proximity to the horizon, the lower limb being more elevated than the upper, while the two extremities of the horizontal diameter are equally raised, its apparent form becomes completely distorted, being neither circular nor elliptical, but a kind of irregular oval, which deviates more from a circle about the lower than the upper part.

Another obvious effect of refraction, is to diminish the duration of darkness, by actually protracting the apparent continuance of the sun and moon above the horizon. For this reason also, the vertical distance between any two stars near the horizon, accurately measured by any instrument, is found to be materially less than when they are at any considerable elevation, the lowest star being most affected by refraction.

If the circle in which the two stars are placed be parallel to the horizon, their apparent distance is also less than the true, for as the effect of refraction is to make them appear in a more elevated parallel than that which they really occupy, and as these parallels become less and less in proportion to their elevation above the horizon, it is obvious that the apparent distance between the two stars diminishes in the same proportion.

To correct the error arising from this cause, Tables of Refraction, (Table 7,) have been constructed, which are among the most important of all astronomical tables, since we are thereby enabled to make proper allowance for the deceptive positions, which under the influence of refraction, the celestial bodies assume.

Notwithstanding the great care with which these Tables have been constructed, yet owing to the almost insuperable difficulties connected with this investigation, it may be reasonably doubted whether the amount of apparent displacement, or the angle by which a celestial body at any assigned altitude, is raised above its true place, as stated in them, can in all cases be relied on.

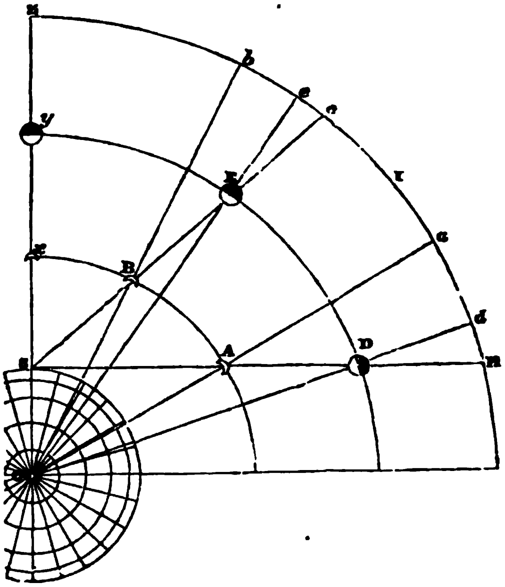
When the air near the surface of the earth or sea becomes more condensed than usual, the rays proceeding from terrestrial objects really out of sight, reach the eye in curve lines, producing those very curious phenomena commonly described as the effects of what is termed terrestrial refraction, whereby the image of an object entirely hidden from view appears in the air, above the place where the invisible object is situated. The images of objects thus presented to the observer are sometimes in erect, and sometimes in an inverted position, the latter effect being caused by the rays proceeding from the upper and lower parts of the real object crossing each other, before they reach the eye of the observer.

Besides the refractive power of the atmosphere, it is endued with a reflective power, by which the sun's light is thrown back to the earth, while his direct rays are intercepted by the horizon, producing the phenomenon called *twilight* or *crepuscular light.*

PARALLAX.

The *diurnal parallax* or *parallax in altitude* is a subject which requires particular explanation.

The diurnal parallax of a heavenly body, is the difference in its apparent place, as viewed from the centre, and from a point on the surface of the earth, and since the parallax diminishes as the distance of the object increases, it follows that the parallax of the moon, on account of her proximity to the earth, is very considerable; that of the sun by reason of his great distance is but trifling; the parallax of a planet is greater or less according to its distance; and the fixed stars, as we have before explained, are so far from having a diurnal, that they have not even an annual parallax, that can be detected by the most delicate observations.



To illustrate this by a diagram, let SC represent a portion of the earth's surface, C its centre, S the station of an observer, Z his zenith, ABx three different positions of the moon, and DEy three places of a planet; also let ZIH represent an arc of the starry heavens comprehended between the horizon and the zenith.

Now to an observer on the surface of the earth at S, when the moon is in the horizon at A, and the planet at D, the latter will be occulted or hidden by the interposition of the former, which will be referred to the point H, but if these objects be viewed by a spectator at the centre C of the earth, the moon will by him be referred to a, and the planet to d, both objects being visible to the spectator so placed, the points a and d are therefore considered as the true places, and H, the visible or apparent place of these bodies, the parallax of the planet will be measured by the arc Hd of the heavens, or by the angle HDd, which is equal to the angle SDC, subtended by the semi-diameter CS of the earth at the planet D; in like manner the arc Ha or angle HAa=SAC, is the moon's parallax, and as both objects are in the horizon of the observer at S, these are called their horizontal parallaxes,

When the moon and planet are above the horizon, as at B and E, their true places as visible at the earth's centre, are at b and e respectively; but as seen by the observer at S, the planet will be again occulted by the moon, apparently at c, and the parallax of the latter will be the arc cb or angle CBb=SBC.

Each of these parallaxes is called the parallax in altitude of its respective body, and is obviously less than the horizontal parallax, the parallax gradually diminishing with the increasing altitude of the body and altogether vanishing in the zenith as at *x* and *y*, being referred to the same point z of the heavens, as viewed from either the centre or the surface of the earth. The planet will in this position obviously be hidden from both observers, by the interposition of the moon.

INTRODUCTORY PROBLEMS.

1. *To convert longitude or degrees, minutes or seconds, of the equator into time*

Rule.—Multiply the arc by 4, observing that seconds multiplied by 4 give *thirds*, minutes multiplied by 4 produce *seconds*, and degrees multiplied by 4 produce minutes, when, therefore, these last exceed 60, they are to be divided by that number, to reduce them to hours and minutes.

Examples.

Required the time corresponding to

10° 27′ 14″
4
cor. time 41m 48s 56th

Required the time corresponding to

51° 10′ 12″
4
3h 24m 40s 48th

2. *To convert time into longitude, or parts of the equator.*

Rule.—Reduce the hours, if any, to minutes, to which bring down the minutes, &c. and divide the whole by 4, observing that the minutes divided by 4 give degrees, the seconds divided by 4 give minutes, and the thirds divided by 4 give seconds.

Examples.

Required the degrees, &c. corresponding to 0h. 42m. 12s.

4) 42m 12s
cor degrees, &c. 10° 33′

Required the arc of the equator corresponding to 11h. 15m. 21s.

11h 15m 21s
60
4) 675 21
corres. arc - 168° 50′ 15″

The above Problems may be solved by inspection, by Table 15, see the Explanation to that Table.

THE GREENWICH DATE,

It has been observed in page 152, that the civil date begins at midnight, and the astronomical date begins at noon; thus the civil date May 5th, 6h P.M. is likewise May 5, 6h. astronomical time; but 6h. A.M. on this day civil date, is 18h. May 4th, astronomical date; it is necessary this should be well understood, because it is to the astronomical time at Greenwich, the calculations are given in the Nautical Almanac.

.3—*The time under any known meridian given to find the corresponding time at Greenwich.*

In *West* longitude. Rule,—Reduce the given longitude into time by Problem 1, and add it to the astronomical date at the given place. If the sum amounts to or exceeds 24 hours, 24 hours must be taken from it, and the remainder will be the time past noon of the *following day.*

Example.—1. Required the Greenwich date when it is 4h. 46m: 10s. in longitude 27° 56'W.

Astronomical date, or time at ship, P.M.	4h	46m	10s
Longitude 27° 56'W. - - - =	1	51	44
Greenwich date - - - - - - -	6	37	54

Example 2.—Required the Greenwich date corresponding to 10h. 11m. 12s. June 24, A.M. (civil time) in long. 136° 18'W.

Astronomical time under the given mer June 23 ...	22h	11m	12s
Longitude 156° 18'W .... =	10	25	12
	32	36	24
Astronomical time at Greenwich since noon June 23.	24		
Astronomical time at Greenwich, June 24	8	36	24

In *East* longitude. Rule,—Reduce the given longitude into time, as before, and if it exceed the time under the given meridian, add 24 hours to the latter, the subtraction being made as before, the remainder will be the time past noon of the *preceding day.*

Example 1.—The time at ship in longitude 122° 12'E. was 4h. 15m May 10th; required the corresponding Greenwich date.

Astronomical date, May 10..........	4h	15m	0s
	24		
Astronomical date, May 9	28	15	0
Longitude in time	8	8	48 E.
Greenwich date, May 9............	20	6	12

Example 2.—What will be the Greenwich date, when it is 22h. 30m. 21s. in longitude 75° 5′E.

Astronomical time under the given meridian ..	22h	30m	21s
Longitude in time.......................	5	0	20 E.
Greenwich date	17	30	1

4.—*Given the Greenwich date, to find the corresponding time under any other given meridian.*

Rule.—In *west* longitude, reduce the longitude into time as before, and *subtract* it from the given time, the difference will be the corresponding time under the given meridian, observing that when the longitude in time exceeds the time at Greenwich or the *Greenwich date*, 24 hours must be added to the latter, then subtracting it as before, the remainder will be the time past noon of the *preceding day.*

Example.—Required the time at ship in longitude 76° 10′W. corresponding to the Greenwich date, July 8, 3h. 12m. 27s.

Greenwich date, July 8 - - -	3h	12m	27s
	24		
Greenwich date, July 7 - -	27	12	27
Long 76° 10′W. - - -	5	4	40
Time at ship, July 7 - - -	22	7	47

When it is noon in 76° 10′W. it will be 5h, 4m. 40s. past noon at Greenwich, consequently the longitude in time will be the Greenwich date in all places in west longitude.

Rule.—In *east* longitude;—reduce the longitude into time as before, and *add* it to the given time, the sum will be the corresponding time under the given meridian, observing that when the sum exceeds 24h, 24 hours must be taken from it, and the remainder will be the time past noon of the *following day.*

Example.—The Greenwich date April 10th. was 20h. 11m. 41s. what was the time in longitude 81° 22′E.

Greenwich date, April 10 - - -	20h	11m	41s
Long. in time - - - - - - - -	5	25	28 E.
Time at ship, April 10 - - - -	25	37	9
	24		
Time at ship, April 11 - - - -	1	37	9

THE REDUCTION OF THE ELEMENTS OF THE NAUTICAL ALMANAC TO THE GREENWICH DATE.

When the Greenwich date is given in apparent time, the declination, right ascension &c. must be taken from page I, but in other respects the calculations are the same.

5.—*To reduce the Sun's declination.*

Rule.—Find the Greenwich date; then from the N.A. page II, take the declination to the nearest noon, and the hourly difference from page I. Reduce the time to hours and decimals of an hour, and multiply the hourly difference by it, then pointing off the proper number of decimals to the right, divide the product by 60 for the minutes, which either add to or subtract from the declination at noon, according as the declination is increasing or decreasing.

Or from Table 31, take the correction answering to the given time, and declination, and apply it as directed at the head of the Table.

Example.—July 22nd. 1852, required the sun's declination at 8h, 36m. Greenwich date,

☉'s dec ... 20° 13′ 14″N.	hourly diff ... 30″58.	6,0) 36m.
— 4 23	× 8·6	
		·6
reduced dec. 20 8 51	18348	
	24464	Table 31,
		Under dec. & opposite 8h36m
	6,0) 26,2·988	20° } 4′ 34″ } diff.
		20° 30′ } 4 16 } 18
	4.23	the p.p. for 13m. subtracted
		from the 4′34″,
		leaves 4′25″nearly, as before.

Required the sun's reduced declination, October 13th, 1852, at 15h. 18m. Greenwich date. Answer,—8° 10′ 41″S.

In reducing the sun's declination at noon to a given meridian, if the longitude (in time) is west, it will express the apparent time at Greenwich, past noon of the given day; but if east, its difference to 24h. will be the Greenwich time past noon of the preceding day.

6.—*To reduce the sun's right ascension.*

Find the Greenwich date as before, then from page II, N.A. take out the right ascension for noon, and the hourly difference; reduce the time as in the example for declination, and multiply the hourly difference by it, reduce the product to *m* and *s*, and add it to the right ascension at noon; if the sum exceed 24h. reject 24h. from it.

Or, in Table 25, find at the top the sun's right ascension, and at the left or right side column, the longitude or given time, at the angle of meeting will stand the correction, to be applied as directed at the head of the Table.

Required the sun's right ascension, February 10th 1852, at 9h. 40m Greenwich date.

☉'s r. a....	21h	33m	26s
	+	1	35
reduced r. a.	21	35	1

h. diff...... 9·882
9·6
59292
88938
6,0) 9,4.8672
1·35

6,0) 40 m.
·6

From Table 25.
Under, and opposite 9h 36m.
21h } 1·38″ } diff. 5
22 } 1·33 }
3′ deducted for the 33m.
from the first, leaves 1′ 35″
as before.

What will be the sun's reduced right ascension, May 13, 1852, at 4h. 13m. Greenwich date.

Answer.—3h. 22m. 21s.

7.—*To reduce the equation of time*

From the N.A. The numbers in the column marked equation, are the values of the equation at the instant of *mean* noon, and therefore serve more particularly to convert mean into apparent time, for which purpose apply the equation according to the precept at the head of the column; for example, if from mean noon, April 1st or 12h. be subtracted the equation 3m. 51·11s. the difference 11h. 56m. 8·89s. A.M, is the corresponding apparent civil time, or March 31st, 23h. 56m. 8·89s. astronomical time.

To find the equation of time at 8h. A.M. mean time, April 15, 1852, in longitude 30° or 2h. W. of Greenwich, add the difference of longitude to the given time, because it is west, and the corresponding astronomical mean time at Greenwich is April 14th. 22h. 0m.

The variation in 24h. (or daily variation,) is 14·90s. that is, the *sum* of the equations belonging to the noons of the 14th and 15th, *because the equation has decreased to* 0 *and then increased in the interval,* therefore, 24h. : 14·90s. :: 22h : 13·66s. the change in the 22h. which being greater than 0m. 10·83s., the equation on the 14th, which was decreasing, shows that in the 22h. the equation has passed through its state of decrease to 0, and is now increasing; the difference 2·83s. is the equation of time at the time proposed, and is to be added to mean time, because it has passed the zero.

To find the equation of time in the same manner as the declination.

Find the Greenwich date as before, then take out from the N.A. the equation of time and hourly difference, reduce the time and multiply this difference by it; if the equation is increasing add the product, but if it is decreasing subtract it.

Example 1.—July 6, 1852, longitude 72°E. at 3h. 34m. P.M. apparent time, find the equation of time.

Time at ship, July 6 ……	3h	34m
	24	
July 5 …..	27	34
Longitude in time……	— 4	48
Greenwich date, July 5 ..	22	46
	24	
Before noon, 6th …….	1	14

	m	s	
Equa. 6th…	4	24·53	
		— 49	
red. eq. time July 5… at 22h 46m.	4	24	4

diff.	·405
	1·2
	·4860

Example 2.—August 19, 1852, longitude 56° 14′W. at 4h. 16m, P.M. apparent time, find the equation of time.

Apparent time at ship, 19th .	4h	16m
Longitude in time……….	3	44·56
App. time, Greenwich, 19th. .	8	0·56

Eq. N. A.	3′	19·65″
diff. in 8h	—	4·65
red. eq. ..	3	15

h. diff .	·582
	8
	4·656

8.—*To reduce the moon's horizontal parallax.*

The moon's horizontal parallax may generally be taken out of the N.A. at sight, as the change in twelve hours is not more than 27″, but where great accuracy is required, apply the following rule.

Find the Greenwich date, then if the Greenwich time is less than 12h. take out the horizontal parallax, for the noon and midnight of the given day; but if it exceeds 12h. take it out for the midnight of the same day, and the noon of the next, the difference between them will be the variation in 12h.

A final correction for the spheroidal figure of the earth is necessary, and is to be subtracted from the equatorial horizontal parallax, according to the latitude of the place of observation.

The Mean Reduction of the Moon's Horizontal Parallax, for the spheroidal figure of the Earth.

Latitude	11°	19	25°	30°	34°	39°	43°	47°	51°	56°	60°	65°	71°	79°	90°
Reduction	1″	2″	2½″	3″	4″	4½″	5″	6″	7″	8″	9″	10″	10½″	11″	

Example 1.—March 29th, 1852, at 2h. 21m. 10s. Greenwich date, required the moon's horizontal parallax ?

hor.. par, at noon, 29th	57′	19·3″	diff. in 12h.
„ midnight …	57	47·1	

27·8″
2·3 hour and decimal of an hour

12) 63·94

5·33

☾'s hor. par. at noon = 57′ 19·3″ + 5·3″ = 57′ 24·6″ the hor. par. at the time required.

Example 2.—March 2nd. 1852, at 7h. 30m. P.M. Greenwich date, required the moon's horizontal parallax.

```
hor. par. 2nd, at noon   58′ 31·3″ ⎫ diff. in 12 h.
                                   ⎬ 12 )28·3
 ,,     ,, midnight      58  59·6  ⎭    ——————
                                        2·358
                                           7½ hours
                                        ——————
                                        16506
                                         1179
☾'s hor. par. at the required time,     ——————
          is therefore 58′ 49″          17·685  17·7″ additional
                                        ══════
```

Table 23 gives a correction for the horizontal parallax and semidiameter at the same time, and as they are usually required together, the corrections can be taken out at once as directed in the Use of the Tables.

9.—*To find the moon's right ascension and declination.*

For the right ascension. Find the Greenwich date, find the difference between the right ascension for the given hour and the next; reduce the minutes and tenths of the Greenwich date to the decimal of an hour and multiply the difference by it, and add the sum to the right ascension for the given hour; if it exceed 24h. reject 24h.

Required the moon's right ascension at 8h. 45m. in longitude 45°E. April 26, 1852.

```
Time at ship 8h 45m  The r. a, at 5h,  8h 5m 19·63s ⎫  m   s
long. in time 3                                      ⎬  2  22·82
             ——————     do.  at 6h,   8  7  41·45   ⎭ 60
Greenw.date  5  45                                    ——————————
             ══════                                   143
                                                       75 reduced time.
                                                      ————
                                                      715
                                                     1001
                                                     ————
                                               6,0 ) 10,7·25
                                                     ———————
                                                     1 47·25 to be added to r.a. at 5h.
                                                     ═══════
```

Required the moon's right ascension, July 31st. 12h. 25m. Greenwich date.

```
R.A. of the ☾ at 12h.  21h 33m 6·12
   do.    ,,     13h.  21  35 16·52
                       ——————————
                          2 10·40
                         60
                       ——————————
                        130·40
                          416     reduced time
                       ——————————
                         78240
                        13040
                        52160
                       ——————————
                        54·24640   54·25s. to be added to the r.a. at 12h.
                       ══════════
```

For the Declination. Find the declination answering to the given day and hour in the Nautical Almanac, and take out the diff. to 10m. which multiply by the minutes and tenths of the given time; the sum, cutting off one more decimal than the required number, divided by 60, will give the required correction.

Required the moon's declination, July 31st, at 12h. 25m. Greenwich date.

Moon's dec. at 12h...	18°	13′	19·1″S.	diff. in 10m..	82·25″
		— 3	25·6		× 25
red. dec. of the moon..	18	9	53·5		41125
					16450
				6,0)	20,5·625
					3 25·6 to be subtracted, as the decl. is decreasing.

The preceding processes may seem tedious to the student well acquainted with the general rules in arithmetic, and he may therefore save himself time, by making use of the following table, to reduce the foregoing elements in the N. A.

3m	=	$\frac{1}{20}$ of an hour,	10m	=	$\frac{1}{6}$ of an hour.
4	=	$\frac{1}{15}$ „	12	=	$\frac{1}{5}$ „
5	=	$\frac{1}{12}$ „	15	=	$\frac{1}{4}$ „
6	=	$\frac{1}{10}$ „	20	=	$\frac{1}{3}$ „

The right ascensions and declinations of the Planets and principal Fixed Stars, required to find the mean or apparent time under any other meridian than that of Greenwich, are to be found in the usual way.

The Moon's age at mean noon,

Is the mean time elapsed since the moon's ecliptic conjunction with the sun, or since the two bodies had the same longitude. The numbers in the Nautical Almanac, page IV. give her age at Greenwich in days and decimal parts of a day.

The Moon's meridian passage,

This column in the Nautical Almanac, likewise page IV. contains the Greenwich mean time to the nearest tenth of a minute, at which the moon's centre is on the *upper* meridian at Greenwich, and is useful to indicate when the latitude may be obtained from an observed meridian altitude of the moon; and likewise, with a table of semidiurnal arcs, (Table 19,) to determine approximately the times of the rising and setting of the moon; it is likewise used in finding the time of high water. Table 21 gives a correction for reducing the time of the moon's passage over the meridian of Greenwich, to the time of her passage over any other meridian, and is to be applied as directed in the Use of the Tables.

10—*To find the meridian passage of the planets.*

Proceed as follows: take the difference of the times of two consecutive transits, and considering this difference as an acceleration or retardation of the meridian passage, while the planet has passed over 24h of geographical longitude, take the proportional part of it due to the difference of meridians, for a correction to be applied to the meridian passage at Greenwich, bearing in mind, that in east longitude the passage precedes that at Greenwich, when the times are accelerated, and follows it, when they are retarded, and the contrary in west longitude.

ON TIME,

It has been observed in the Definitions, (page 151) that *a day* is the interval of time between the departure of any meridian from a heavenly body and its next return to it, and is named from the body performing that revolution; thus the departure and the return of any meridian to the sun is called a *solar day*, to the moon a *lunar day*, and to the star, a *sidereal day*.

The time deduced from observation of the *true* sun, is called *true* or *apparent* time; and the time deduced from the imaginary sun, used by astronomers to represent the true sun's *mean* motion, is called *mean* time; therefore

11.—*To convert apparent into mean time,*

Find the Greenwich date in apparent time, and apply the equation of time, page I, N.A. (reduced to the Greenwich date,) as directed at the head of the column.

If the equation of time when subtractive exceed the apparent time, add 24h. to the latter, and date the time on the day before.

12.—*To convert mean into apparent time,*

Reduce the equation of time from page II, to the Greenwich date, as before, and apply it to the *mean* time, as there directed; if, as before, the equation of time, when subtractive, exceed the mean time, add 24h. to the latter, and date the time on the day before, see pp. 150 and 152.

13.—*To convert intervals of mean solar time into equivalent intervals of sidereal time.*

Enter Table 43 with the mean time, and take out the corresponding sidereal time.

14.—*To convert intervals of sidereal time into equivalents of mean solar time,*

Enter the Table page 594 in the N.A. with the sidereal time, and take out the corresponding mean time.

A reference to these Tables in the N.A. and the examples given with them, will further explain the conversion of the times.

15.—*To correct the altitudes.*

Given the observed altitude of the upper or lower limb of the sun, to find the true altitude of his centre.

Rule.—Correct the observed altitude of the sun, for index error, if any.*

Subtract the dip answering to the height of the eye above the horizon by Table 8, and the remainder will be the *apparent* altitude of the observed limb.

From the apparent altitude subtract the correction corresponding to it (Table 13,) for refraction and parallax, and the remainder will be the *true* altitude of the observed limb.

To the last remainder add the sun's semidiameter, taken from p. III of the month in the N.A., if the lower limb be observed; but subtract it if the upper limb be taken, and the remainder will be the true altitude of the sun's centre.

Examples.

1.—May 17th. the meridian altitude of the $\underline{\odot}$ was observed to be 68° 43′ the height of the eye 16 feet; required the true altitude of the sun's eentre, no index error.

observed alt. ⊙'s l.l.	68°	43′
dip, Table 8	—	4
app. alt. ⊙'s l l.	68	39
correction for refraction and parallax, Table 13.........		0
sun's semidiameter, N.A......	+	16
true altitude sun's centre	68	55

2.—April 16th, the observed altitude of the $\overline{\odot}$ was 75° 20′ 15″, the height of the eye 24 feet, index error + 1′; required the sun's true central altitude.

obs. alt. ⊙'s u.l.........	75°	20′	15″
index error.............	+	1	0
	75	21	15
dip, Table 8	—	4	42
app. alt. sun's upper limb.	75	16	33
cor. Table 13, for refraction and parallax......	—		13
true alt.⊙'s u.l.........	75	16	20
sun's semidiameter.......	—	15	57
true alt. sun's centre....	75	00	23

---

* Whenever there is an index error, the observation, whether for altitude or distance must always be corrected for that error *before* any other correction is made.

16.—*Given the observed altitude of the upper or lower limb of the moon, to find her true central altitude.*

Rule.—Turn the longitude into time and add it to the apparent time of observation if west, but subtract it if east, for the corresponding time at Greenwich.

From page III of the month in the N.A. take out the moon's semidiameter and horizontal parallax, which reduce (page 164) to the mean time at Greenwich, and to the semi-diameter add the augmentation. Table 22.

From the true observed altitude of the moon, subtract the dip, Table 8, and to the remainder add the moon's augmented semidiameter, if the lower limb be observed, or subtract it from the remainder, if the upper limb be taken, the sum or difference will be the apparent altitude of the moon's centre.

To the moon's apparent altitude, add the correction, Table 24, the sum will be the true altitude of the moon's centre.

Example.—1. March 15, 1852, at 4h. 22m. 30s. by chronometer, which was 33m.10s. slow for mean time Greenwich, the observed altitude of the moon's lower limb was 53° 30′ 40″, height of the eye 12 feet; required the true altitude of the moon's centre?

Chronometer, 15th......	4h 22m 30s	☾'s red. semd.	15′	8·2″	red. hor. par.
slow	+ 33 10	augmentation.	+	12·6	55′ 33″
mean time Greenwich	4 55 40	true semid....	15	20·8	

obs, alt. ☾'s l.l.	53°	30′	40″
dip, Table 8	—	3	19
	53	27	21
☾'s true semidiameter.....	+	15	21
app. alt. ☾'s centre.......	53	42	42
cor. Table 24............	+	32	10
true altitude ☾'s centre...	54	14	52

2. March 2, 1852, at 7h. 43m. 46s. by chronometer fast on Greenwich mean time 13m. 46s. the observed altitude of $\overline{☾}$ was 46° 12′ 10″, height of eye 21 feet; required the true altitude of ☾'s centre.

time by chronometer	7h 43m 46s	☾'s red. sem.	16′	1·6″
fast..................	— 13 46	augmentation.	+	11·4
mean time Greenwich	7 30 00	true semidiam. +	16	13
		red. hor. parallax...	58′	49″

☾'s obs. alt. u.l.	46°	12′	10″
dip. Table 8	—	4	23
	46	7	47
☾'s true semidiameter....	—	16	13
app. alt. ☾'s centre......	45	51	34
cor. Table 24...........	+	40′	3″
true alt. ☾'s centre......	46	31	37

17.—*Given the observed altitude of a planet's centre, to find its true altitude.*

From the planet's observed central altitude, corrected as before for index error, subtract the dip of the horizon, the remainder is the apparent central altitude.

Find the difference between the planet's parallax in altitude, Table 26, and its refraction, Table 7; add this difference to the apparent central altitude, when the parallax is greater than the refraction, but subtract it when it is less, the sum or remainder will be the true central altitude of the planet.

Ex. 1—March 2, 1852, the observed altitude of Venus was 33° 18′ 30″ height of eye 22 feet, her horizontal parallax 7″, required the true central altitude.?

obs. central altitude......	33°	18′	30″	
dip, Table 8	—	4	30	
app. central altitude	33	14	0	
refr. T. 7—1′ 27″ par. T.26 + 6 } ..	—	1	21	
	33	12	39	true central altitude Venus.

2—June 16, 1852, the observed altitude of Jupiter was 27° 50′, height of eye 18 feet, and horizontal parallax 1·9″, required his true central altitude ? index error 10″ to subtract.

Jupiter's observed altitude - - -	27°	50′	00″	
index error - - - - - - - - - -	—		10	
	27	49	50	
dip, Table 8 - - - - - - - -	—	4	4	
app. central alt. - - - - - -	27	45	46	
refr. Table 7 — 1′ 48″ par. Table 26 - — 2 }	—	1	46	
	27	44	00	true central alt. of Jupiter

In taking the altitude of a planet, its centre should be brought down to the horizon. If the parallaxes of the planets be determined by means of a comparison of their respective distances from the earth, with the earth's semi-diameter, they will be found to be nearly as follows:

Venus's greatest horizontal parallax,	about	32″	least 5″
Mars „ „		19″	„ 3″
Jupiter mean horizontal parallax	„	2″	
Saturn „	„	1″	

The parallaxes of the two last are subject to very trifling variation, their distances from the earth, rendering any alteration in their parallaxes, nearly imperceptible.

18.—*Given the observed altitude of a fixed star, to find its true altitude.*

Rule.—From the observed altitude of the star subtract the dip of the horizon, the remainder will be the apparent altitude. From this subtract the refraction, and the remainder will be its true altitude.

Example 1.—May 3, 1852, the observed altitude of Arcturus was found to be 44° 36′, height of eye 10 feet, index error 3′ 20″ subtractive; required the true altitude.?

obs. alt. of star	44°	36	0″
index error	—	3	20
	44	32	40
dip, Table 8	—	3	2
apparent altitude	44	29	38
refraction, Table 7	—		58
true altitude of Arcturus	44	28	40

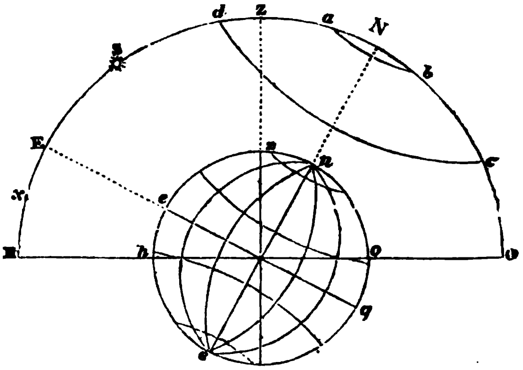
2.—February 19th, 1852, the observed altitude of Sirius was found to be 56° 20′, height of eye 18 feet, required the true altitude. ?

observed altitude of star	56°	20′	0″
dip, Table 8	—	4	4
apparent altitude	56	15	56
refraction, Table 7	—		38
true alt. of Sirius	56	15	18

A reference to the Fixed Stars, page 142, will show that they have no sensible semidiameters nor parallaxes.

ON FINDING THE LATITUDE.

BY OBSERVATION.



The latitude of any station on the earth's surface, may be determined in various ways; but the readiest method of solving this problem, is derived from a well known property of the sphere, viz:—that the *elevation* or *altitude* of the pole above the horizon of any place, is equal to the latitude of that place, thus, in the annexed diagram, let *h z o s* be the earth, *n s* its axis, *e q* the equator, *z* the place of the observer, and *o n* the elevation of the pole: also, let H Z O be an arc of the heavens, Z the zenith of the place *z*, E *e* the celestial equator, H *h o* O the horizon, N the celestial pole, and N O its altitude or height above the horizon, coinciding with *n o*, the elevation of the pole of the earth.

Now, Z O the distance from the zenith to the horizon, or the corresponding arc *z o* of the terrestrial meridian is 90°: EN the distance of the equinoctial from the pole, or its corresponding arc *e n* is also 90°: and Z N or *z n* is common to these two equal quantities, and may therefore be taken from both, and the remainders E Z, and N O, or *e z* and *n o* will be equal; but *e z* is the latitude or distance of the place Z from the equator, and *n o* is the elevation of the pole, with which N O the altitude of the celestial pole coincides, therefore the elevation of the pole of the earth, or the altitude of the celestial pole, is equal to the latitude of the place.

The pole being a point in the meridian, if any star were fixed exactly in that point, the latitude of the place of observation would be at once obtained by taking the altitude of the star by any proper instrument, and correcting this observed altitude for refraction. As, however, this is not the case, any bright circumpolar star, or star that does not descend below the horizon, may be selected, and its altitude observed in its *upper* and *lower* culminations, that is, when it passes the meridian *above* and *below* the pole.

These observations being corrected for refraction, half their sum will be the true altitude of the pole, or the latitude of the place of observation. Thus, in the above diagram, if *a* O be the altitude of the circumpolar star in its upper culmination, or when on the meridian above the pole, and *b* O its altitude, when on the meridian below the pole, or in its lower culmination, the true altitude of the polar point N is obviously an arithmetical mean between the two altitudes.

We have in this example supposed the star, in its upper culmination, to pass the meridian between the pole and the zenith, and then its greatest altitude will be its distance from the north point of the horizon, but it may pass to the south of the zenith. Thus, suppose *c* O to be the altitude of the star below the pole, then in its upper culmination, the same star will be at *d*, when being south of the zenith, its altitude is the arc *d* H, measured from the south point of the horizon: this must therefore be subtracted from 180° to obtain the distance from the north point of the horizon, and half the sum of the two distances, as before, will be the latitude.

If, instead of the greatest and least altitudes of a star, its greatest and least distances be found (both being on the same side of the zenith) and corrected for refraction, half their sum will be the *complement* of the latitude, or what the latitude wants of 90°.

The latitude is more generally found at sea, by taking the sun's altitude at noon by a sextant or quadrant, this observed altitude being corrected for dip, semi-diameter, refraction and parallax, is then taken from 90°, and the remainder is the sun's *zenith distance*, which is north, if the sun be south of the observer when the altitude is taken, and *vice versa*. The sun's declination is taken from the Nautical Almanac, and reduced to the meridian of the ship or place of observation, then if the zenith distance and declination are both north or both south, their sum, but if they are of contrary names their difference, is the latitude, and is always of the same name with the greater quantity.

Thus, let HS be the true altitude of the sun on the meridian of the place Z, then SZ is the sun's zenith distance N. SE is the sun's declination which is also N. therefore the angular distance $SZ + SE =$ the angular distance ez, the latitude of the place z. Had the sun been at X, his meridian altitude would have been Hx, his zenith distance xz, and his declination Ex, which being S. and the zenith distance N. the latitude is $xz - Ex = EZ$ or ez as before.

The latitude may in like manner be obtained, by taking the meridian altitude of the moon, a planet or fixed star whose declination is known, by making such variations in the corrections of the observed altitude, and the declination, as the circumstances of the different objects require. These various methods are exemplified in the following rules.

To find the latitude by a meridian altitude of the sun.

Rule.—Correct the observed altitude of the sun, (p. 168), for index error, if any.

Subtract the dip, answering to the height of the eye above the horizon, (Table 8,) the remainder will be the *apparent* altitude of the observed limb.

From the apparent altitude, subtract the correction corresponding to it, (Table 13,) the remainder will be the *true* altitude of the observed limb.

To the last remainder add the sun's semidiameter, if the lower limb be observed, but subtract it if the upper limb be taken, and the result will be the true altitude of the sun's centre.

Or when the altitude of the sun's lower limb is observed, the joint effect of the corrections may be taken at once from Table 14, and being added to the true observed altitude of the lower limb, will be the true altitude of the sun's centre.

Subtract the sun's true altitude from 90°, the remainder will be the sun's true zenith distance, which is to be called north if the sun be south of the observer when the altitude is taken, but south if the sun be north of him.

Take the sun's declination from Table 16, and correct it for the longitude of the ship by Table 17, whether it be north or south.

Then, if the zenith distance and declination be of the same name their *sum*, but if of different names, their *difference* will be the latitude of the same name with the greater.

When the horizon under the sun is obstructed by land, the dip is to be taken from Table 9 instead of Table 8.

Ex 1—If at sea October 10, 1852, in longitude 60° 10′E., the observed meridian altitude of $\overline{\odot}$ be, 60° 42′, the observer being S. of the sun, the height of the eye 20 feet, and the index error 1′ 40″ to add; required the latitude. ?

obs alt. ⊙'s u.l.	60	42	0N.
index error	+	1	40
true obs. alt. ⊙'s u. l. ...	60	43	40
dip, Table 8	–	4	17
app. alt.	60	39	23
refraction, Table 7.......	—		32
	60	38	51
parallax, Table 10	+		4
true alt ⊙'s u l.	60	38	55
semidiam. N.A. p II....	—	16	3
⊙'s true alt	60	22	52N.
	90		
⊙'s true zenith distance .	29	37	8 S.
⊙'s red. dec	6	44	38 S.
Latitude	36	21	46 S.

⊙'s dec, (N,A. p. 1)...	6°	48′	26.2″S.
dif. 1 h=56·95″cor. forlong.	— 3		48·4
⊙'s red. dec..........	6	44	37·8

Ex. 2.—Suppose January 2, 1852, in longitude 21°W. the meridian altitude of $\underline{\odot}$ to be 33° 46′ 45″ the observer being N. of the sun, height of his eye 16 feet, index error 15″ to add; required the latitude?

⊙'s dec. (N.A. p.1)..	22°	58′	29·4″S.
cor. for long.W. T.31.	—		17
⊙'s red. dec.	22	58	12·4

obs. alt. ⊙'s l.l.	33°	46′	45″S
index error..	+		15
true obs. alt. ⊙'s l l.	33	47	0
dip. T. 8..............	—	3	50
app. alt. ⊙'s l.l..........	33	43	10
refr. and par. T. 13......	—	1	18
true alt. ⊙'s l.l..	33	41	52
semidiam. N A. p.II.....	+	16	17
true alt. ⊙'s centre......	33 90	58	9 S.
⊙'s true zen. distance....	56	1	51 N
⊙'s red. dec............	22	58	12S.
Latitude..............	33	3	39 N

Or, by second method,

true obs. alt. ⊙'s l.l. ...	33°	47′	0′
cor. T. 14............	+	10	59
⊙'s true alt...........	33 90	57	59
⊙'s true zen. distance....	56	2	1
⊙'s red. dec.......	22	58	12 S.
Latitude	33	3	49

Examples for Exercise.

1. Suppose April 3rd. 1852, in longitude 12°W. the meridian altitude of $\underline{\odot}$ to be 44° 19′ 30″S. the height of the eye 20 feet, and index error 1′ 30″ to subtract; required the latitude?

Answer.—51° 0′ 55″N.

2. If at sea Oct. 19, 1852, in longitude 42°E. the observed meridian altitude of $\overline{\odot}$ be 50° 10′S. the height of the eye being 12 feet; what latitude will the ship be in?

Answer.—30° 4′ 1″N.

3, June 11, 1852, in longitude 63 E. the observed altitude of $\underline{\odot}$ being 42° 24′ 45″N. the height of the eye 21 feet, and the index error 2′ 15″ to add; required the latitude.

Answer. -24° 15′ 41″S.

4. December 15, 1852, in longitude 177°E. the observed meridian altitude of $\overline{\odot}$ being 45° 45′S. the height of the eye 20 feet, and the distance of the land under the sun 2 miles; required the latitude?

Answer.— 21° 22′N. ?

5.—July 20, 1852, in longitude 154°W. the meridian altitude of $\underline{\odot}$ being 51° 42′ 30″, the observer N. of the sun, and the height of the eye 24 feet; required the latitude?

Answer.—58° 38′ 46″N.

6.—Feb. 17, 1852, in longitude 96° 30′ 45′W. the meridian altitude of $\overline{\odot}$ being 74° 30′ 20′N, the height of the observer's eye 21 feet, and index error 2′ 20″ to subtract; required the latitude?

Answer.—27° 56′ 56″S.

To find the latitude by the meridian altitude of a fixed star.

Rule.—Take out the star's declination from Table 12, and reduce it to the time of observation, as explained in the use of the Table.

From the true observed altitude of the star subtract the dip, (Table 8) and refraction, (Table 7,) the remainder will be the star's true altitude, as explained page 171, problem 18, which taken from 90° will give the meridional zenith distance, which will be north or south, according as the observer is north or south of the star, at the time of observation. Now if the zenith distance and declination be of the same name, their sum will be the latitude of the ship or place of observation, but if of contrary names, their difference will be the latitude, of the same name with the greater term.

Example. Suppose June 20, 1852, the meridian altitude of Vega was observed to be 46° 32′N. the height of the eye 16 feet, and the index error 45″ to add; required the latitude.?

obs. alt. of Vega	46°	32′	0″N.
index error	+		45
	46	32	45
dip (T. 8)	—	3	50
	46	28	55
refraction, (T.7)	—		54
star's true altitude	46	28	1N.
	90		
zenith distance	43	31	59S.
declination of Vega	38	38	56N.
Latitude	4	53	3S.

Examples for Exercise.

2—Jan. 24, 1852, in longitude 36°E. the observed meridian altitude of Markab being 45° 10′S. the height of the eye 10 feet, and index error 1′ 15″ to subtract; required the latitude.?

Answer.—59° 19′ 51″N.

3. January 4, 1852, the observed meridian altitude of the star Sirius being 46° 16′ south of the observer, the height of the eye 18 feet, and index error 4′ 20″ to subtract; required the latitude?

Answer.—27° 22′ 13″N.

4. December 20, 1852, the meridian altitude of the star Antares being 49° 36′N. and the height of the observer's eye 20 feet; required the latitude?

Answer.—66° 35′ 2″S.

5. Suppose March 6, 1852, the observed meridian altitude of *a* Arietis to be 52° 10′ 30″S. the height of the eye 18 feet, and the index error 15″ to add; required the latitude?

Answer.—60° 39′ 34″N.

To find the latitude by the meridian altitude of a planet.

The operation for determining the latitude by the meridian altitude of a planet, is the same as that of a fixed star, only observing, that the declination of the planet is to be taken from the N.A. pp. 268 to 431, instead of Table 12, and reduced to Greenwich mean time; then

Correct the altitude for index error, dip, and refraction, find the zenith distance, and proceed as before; the parallax of a planet is of too little consequence to require notice, in determining the latitude for nautical purposes.

Example.—In longitude 18° 20′W. May 1, 1852, the meridian altitude of the planet Venus* ♀ l.l. was 26° 40′N. the height of the eye 24ft. index error 3′ 20″ to add; required the latitude?

	h	m	s
cor. mer.pas.Venus,long 18°20′W.	3	5	18
long. in time West	1	13	20
Gr. mean time, May 1	4	18	38
obs. alt. of ♀	26	40	0N.
index error	+	3	20
true obs. alt.	26	43	20
dip, T. 8	—	4	42
app. alt.	26	38	38
refr. T. 7	—	1	53
	26	36	45
par. T. 26	+		10
true alt. ♀ l.l	26	36	55
semd. ♀ N.A.	+		10
♀ true alt.	26	37	5N.
	90		
♀ zen. dist	63	22	55S
♀ red. dec.	26	27	46N.
latitude	36	55	9 S.

dec. of ♀	26°	27′	14·2″N.
dif. 1h. 7·4″ × 4 19	+		31·8
red. dec. of Venus	26	27	46 N.

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* The planet Venus may sometimes be seen at mid-day.

Examples for Exercise.

1. June 2, 1852, in longitude 170°W. the meridian altitude of the planet Jupiter, ♃ (l.l.) is 56° 20′ 40″N. the height of the eye 14 feet, and index error 2′ 20″ to add; required the latitude?

Answer.—49° 4′ 9″S.

2. August 31, 1852, in longitude 94°E. the meridian altitude of the planet Saturn ♄ (l.l.) is 38° 40′ 30″S. the height of the eye 18 feet, and index error 3′ 30″ to subtract; required the latitude?

Answer.—66° 18′ 8″S.

3. January 31, 1852, in longitude 134° 40′W. the meridian altitude of the planet Mars ♂ (l.l.) being 40° 2′ 30″N. the height of the eye 14 feet, and index error 2′ 10″ to subtract; required the latitude?

Answer.—25° 46′ 15″S.

To find the latitude by the meridian altitude of the moon.

Rule.—Reduce the moon's passage over the meridian of Greenwich, on the given day, (taken from page IV of the month in the Nautical Almanac) to the meridian of the ship, or place of observation, by Table 21.

With the time of the moon's passage over the meridian of the ship, and the ship's longitude, find the corresponding Greenwich mean time, by the rule already given for that purpose, or by Table 15.

From page III of the month in the Nautical Almanac, take out the moon's semidiameter, and horizontal parallax; reduce them to the mean time at Greenwich, by rules page 164, and to the semidiameter add the augmentation, Table 22.

Take out the moon's declination from pages V to XII of the month in the Nautical Almanac for the given day and hour at Greenwich, and reduce it to the Greenwich mean time, by the rule given in the explanation to those pages in the Nautical Almanac, or as explained in page 165.

From the true observed altitude of the moon, subtract the dip of the horizon, (T. 8.) and to the remainder add the moon's augmented semidiameter if the lower limb be observed, or subtract it from that remainder if the upper limb be taken, the sum or difference will be the apparent altitude of the moon's centre.

To the moon's apparent altitude add the correction (T. 24.) the sum will be the true altitude of the moon's centre, which taken from 90° will give the zenith distance, which is called north or south, according as the observer is north or south of the moon; under this set the reduced declination.

Then if the zenith distance and declination are of the same name, their sum, but if of contrary names their difference will be the latitude, of the same name with the greater.

Example. November 30, 1852, in longitude 37° 20′W. the observed meridian altitude ☾ being 51° 10′ 40″N. the height of the eye 19 feet, and index error 45″ to add; required the latitude.

Moon's mer pass. at Greenwich (N-A. p.IV)	15h	23·1m	
cor. for long. 37° 20′W. and daily var. 52 (T·21).......	+	5	
☾'s mer. pass. at ship.........	15	28	6
long. in time	2	29	20
mean time Greenwich	17	57	26

☾'s semd. at 18h. (N.A.p.III) 15′ 16″ + aug.(T.22) 12″ = 15′ 28″ ☾'s aug. semd.

☾'s hor. par. 56′ 1″ (N.A.)

obs. alt. ☾'s l.l	51°	10′	40″N.
index error.............	+		45
true obs. alt......	51	11	25
dip	—	4	11
app. alt.....	51	7	14
aug. semd...............	+	15	28
app. alt. ☾'s centre	51	22	42
cor. (T 24)............	+	34	12
true alt. ☾'s centre	51	56	54N.
	90		
☾'s zen. dist............	38	3	6S.
☾'s red dec............	22	53	49N.
latitude.........	15	9	17 S.

☾'s dec. Nov.30 at 17h. .	22°	57′	51″N
dif. for 10m. 42·55 × 5·7 =	—	4	2
red. decli.	22	53	49

Examples for Exercise.

1.—March 31, 1852, in longitude 110°E. the observed meridian altitude of ☾ being 62° 10′ 30″N. the height of the eye 16 feet, and index error 4′ 10″ to add; required the latitude?

Answer.—8° 5′ 8″S.

2—May 30, 1852, in longitude 42° 10′W. the observed meridian altitude of ☾ being 47° 31′ 40″S. the height of the eye 20 feet, and index error 2′ 20″ to subtract: required the latitude?

Answer.—31° 24′ 52″N.

3. October 31, 1852, in longitude 152°W. the observed meridian altitude of ☾ being 39° 10′ 50″N. the height of the eye 14 feet, and index error 1′ 40″ to add; required the latitude?

Answer.—27° 0′ 48″S.

4. March 4, 1852, in longitude 130°E. the observed meridian altitude of ☾ being 78° 20′ 20″S. the height of the eye 24 feet, and index error 25″ to subtract; required the latitude?

Answer.—29° 3′ 36″N.

To find the latitude by an altitude of the Polar Star.

RULE.—To the sidereal time mean noon, taken from the Nautical Almanac page II, add the sidereal time answering to the apparent time of observation, (Table 43) and the sum (rejecting 24h. if necessary) will be the mid-heaven, or right ascension of the meridian.

Find the true altitude of the star page 171, with the right ascension of meridian enter Table 28, and take out the corresponding correction, which correction being applied by addition or subtraction (as directed in the Table) to the star's true altitude, will give the approximate latitude; to this add the correction taken from Table 29, and the sum will be the latitude sought.

The time of the stars passing the meridian may be deduced from Table 20, and it should be remarked that the nearer the star is to the meridian, either above or below the pole, when the observation is made, the less will be the error in latitude arising from an error in the supposed time; however an error amounting even to 20 minutes in the apparent time, will not affect the latitude more than 8·5 minutes, even at the star's *greatest distance from the meridian*, and when *on* meridian either above or below the pole, will not produce an error of half a minute in the latitude. Now as it is scarcely to be expected the error in the apparent time should amount to *one-half* or even a *quarter* of that specified above, it is obvious that this method of determining the latitude, although confined to places situated in the northern hemisphere, is particularly worthy the attention of the mariner.*

Example.—June 25, 1852, at 8h. 48m. 23s. p.m. mean time, the observed altitude of the polar star being 34° 26′ and the height of the eye 16 feet: required the latitude.

sidereal time, mean noon, (N.A p.II.)	6h	15m	6s
mean time, 8h 48m 23s = sidereal time, Table 43.	8	49	50
sidereal time, Greenwich...	15	4	56

✱ obs. alt.	34°	26′	0″
dip, (T.8)	—	3	50
✱ app alt.	34	22	10
refr. (T.7)	—	1	23
✱ true alt.	34	20	47
cor. (T.28)	1	17	0
approx. lat.	35	37	47
cor (T.29)	+		15
latitude.	35	38	2N·

By Nautical Almanac, latitude, 35° 40′ 6″N.

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* Rules and Tables for finding the Latitude by an altitude of the Polar Star, to the nearest second, will be found in the Nautical Almanac.

Examples for Exercise.

1. November 24, 1852, at 7h. 45m. P.M. in longitude 20°W. the altitude of the polar star being 47° 40′ 20″, the height of the eye 17 feet, and index error 1′ 10″ to add; required the latitude?

Answer.—46° 10′ 41″N.
by N.A. 46 11 54 N.

2.—May 6, 1852, at 10h. 30m. 30s. P.M. in longitude 40° 20′W. the altitude of the polar star being 50° 30′, the height of the eye 21 feet, and index error 2′ 40″ to subtract; required the latitude?

Answer.—51° 50′ 7″N.
by N.A. 51 51 37N.

3. September 19, 1852, at 10h. 40m. P.M. the observed altitude of the polar star being 40° 30′ 40″, and the height of the eye 16 feet; required the latitude?

Answer.—39° 15′ 33″N.
by N.A. 39 16 49 N.

4. May 2, 1852, at 8h. 40m. 20s. P.M. mean time, the observed altitude of the polar star being 60° 10′, the height of the eye 14 feet, and index error 2′ 40″ to subtract; required the latitude?

Answer.—61° 23′ 46″N.
by N A. 61 24 0 N.

*To find the latitude by a meridian altitude below the pole.**

When the latitude of the place of observation, and the declination of a celestial body are both of the same name, if the former exceed the complement of the latter, the celestial body will be circumpolar, that is, it will come to the opposite meridian without setting at that place, and is then said to be on meridian below the Pole, in which situation, if the altitude of the body be taken, the latitude of the place may be found by the following

RULE.—Correct the declination of the object and subtract it from 90° the remainder will be its co-declination, which being added to its true altitude (found as before,) will give the latitude of the place of observation, of the same name with the declination.

The sun is on the meridian below the pole 12h. after noon, therefore, if the longitude in time be added to or subtracted from 12h. according as it is west or east, the Greenwich time at which the sun will be below the pole will be found. If to the time of the moon's passing the meridian, 12 hours, and half the daily difference of her passing the meridian be added, the sum will be the time at which she will be below the pole; if 12 hours be added to the time at which a planet is on the meridian, the sum will be the time at which it is below the pole, at least sufficiently exact for computing its declination for the latitude.

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* The apparent time of the inferior transit of a fixed star over the opposite meridian, or the time of its coming to the meridian below the pole, may be found by adding 12h. diminished by half the daily variation of the sun's right ascension, to the apparent time of the superior transit of the said star.

The least altitude of a circumpolar celestial object takes place at the instant of its being on the meridian below the pole.

Ex.—June 18, 1852, in longitude 20°E. the meridian altitude of ☉ observed below the pole being 9° 17′ 32″ the height of the eye 18 feet, and index error 25″ to subtract; required the latitude?

app. time at ship ...	12h	0	
long. in time E. ...	1	20	
app. time Greenwich .	10	40	
☉'s dec. (N.A.p I.)	23°	25′	51″N.
dif. 1h. 2·40 × 10⅔ .... =	+		25·6
☉'s dec. Grnwh. time	23	26	16·6
	90		
☉'s co. dec.............	66	33	43 4

obs. alt. ☉'s l.l.	9°	17′	32″	
index error.............	—		25	
true obs. alt. ☉'s l.l.....	9	17	7	
dip, (T. 8)..............	—	4	4	
app. alt. ☉'s l.l.........	9	13	3	
refr. and par. (T.13)	—	5	32	
true alt. ☉'s l.l-	9	7	31	
☉'s semidiameter	—	15	45	
☉'s true alt.	8	51	46	
☉'s co-dec.............	66	33	43	N.
latitude.................	75	25	29	N.

Examples for Exercise.

1. June 19, 1852, in longitude 30°W. the meridian altitude of ☉ when on the meridian below the pole being 8° 10′ 20″ and the height of the eye 10 feet; required the latitude?

Answer.—74° 49′ 40″N.

2. In longitude 30°W. July 16, 1852, the altitude of Capella on the meridian below the pole, being 21° 30′, the height of the eye 14 feet, and index error 2′ 10″ to add; required the latitude?

Answer.—65° 35′ 48″N.

3. November 30, 1852, in longitude 74°E. the altitude of Fomalhaut, on the meridian below the pole, being 10° 4′ 15″, the height of the eye 24 feet, and index error 1′ 20″ to add; required the latitude?

Answer.—69° 31′ 22″S.

4. January 4, 1852, in longitude 78° 50′W. the altitude of Achernar, on the meridian below the pole, being 31° 40′ 40″, the height of the eye 20 feet, and index error 4′ 30″ to subtract: required the latitude?

Answer.—63° 30′ 32″S.

5. In longitude 162°E. on December 31, 1852, the altitude of ☉, on the meridian below the pole being 5° 40′ 20″, the height of the eye 18 feet, and index error, 3′ 20″ to add; required the latitude. ?

Answer.—72° 42′ 45″S.

Moon's meridian altitude below the pole.

Example.—June 19, 1852, in longitude 96° E the meridian altitude of ☾ below the pole being 6° 20′ 30″ the height of the eye 19 feet and index error 3′ 10″ to subtract: required the latitude ?

Moon's mer. pass at Greenwich (N.A.p.IV) - - - -	1h	39m	
cor. for long. 96°E. and daily variation 55m (T.21) - -	—	14	
	1	25	
cor. for pass. at ship (obs. below pole) 12h + half daily var.)	12	27	30
pass. at ship below the pole - - - - - - - - - -	13	52	30
long. in time E. - - - - - - - - - - - - - -	6	24	
mean time at Greenwich - - - - - - - - - - -	7	28	30

Moon's hor. par. at 7½h = 57′ 6″ Moon's semidiam. at 7½h = 15′ 33″

Moon's semidiam. + aug. = 15′ 33″ + 2″ = 15′ 35″

obs.alt. ☾'s l.l.	6°	20′	30″
index error	—	3	10
true obs.alt. ☾'s l l	6	17	20
dip, (T 8)	—	4	11
app alt ☾'s l.l.	6	13	9
☾'s aug. semidiam.	+	15	35
app. alt. ☾'s centre	6	28	44
cor. (T.24)	+	48	50
☾'s true alt.	7	17	34
co.-dec.	67	13	39N.
latitude.	74	31	13N.

☾'s dec. June 19, at 7h. (N.A.p.110)	22	47	43·5N.
dif. for 10m. 29·05 × 2·85 =	—	1	22·8
red. dec.	22	46	20·7
	90		
co.-dec.	67	13	39·3N.

Example for Exercise.

1. November 14, 1852, in longitude 18° 25′ W. the meridian altitude of ☽ below the pole being 7° 19′ 40″, the height of the eye 22 feet and index error 2′ 40″ to add: required the latitude ?

Answer, 73° 49′ 4″S.

LATITUDE BY DOUBLE ALTITUDES.

To find the latitude and apparent time, by two altitudes of the sun and the time elapsed between the observations.

If a chronometer be used for noting the time, thence to find the longitude by chronometer.

On the correction of altitude for change of place.

This useful problem is solved upon the supposition, that both observations of the sun, are taken at the same spot, but, a ship at sea, in the progress of her passage, when the second altitude is taken, is generally several miles distant from the place where the first altitude was observed. Therefore it is necessary to correct the first altitude, for the change which has taken place in the ship's position, during the elapsed time between the first and second observations, because, in most cases, the navigator requires his latitude at the second observation. There are two cases where this correction is required

1. The ship sails towards the sun and raises him after the first observation, therefore the first altitude will be higher at the second position, consequently the first altitude requires a correction to be *added* to it.

2. The ship sails from the sun and depresses him after the first observation, therefore the first altitude will be lower at the second position, and requires a correction to be *subtracted* from it.

The angle contained between the ship's course and the sun's bearing, (which must always be taken at the first observation,) determines, whether the ship sails *towards*, or sails *from* the sun, and also regulates the quantity of the correction, with respect to the distance sailed in the elapsed time.

Thus if the course be E.bS. and the sun bear E.bS. the angle is 0, and the first altitude must have the whole distance sailed in the elapsed time, *added* to it as a correction for change of station.

Again, if the course be W.S.W. and the sun bear E.N.E. the ship sails directly from the sun, and every mile sailed during the elapsed time, must be *subtracted* from the first altitude.

If the angle be less than eight points, enter Table I or II with the angle and distance sailed during the elapsed time, take out the corresponding difference of latitude and add it to the first altitude, because we always approach the sun, when the angle is less than eight points or 90°.

If the angle be more than eight points, subtract it from sixteen points, with the remainder, as the angle and the distance sailed, enter Table I or II, the corresponding difference of latitude must be subtracted from the first altitude, because we always sail from the sun, when the angle is greater than eight points, or 90°.

When the angle between the ship's course and the sun's bearing at the first observation is eight points or 90°, the first altitude requires no correction for change of station.

In the above precepts for correcting the first altitude, the Traverse Tables are used, as the readiest means of solving a right angled plane triangle, of which the difference of latitude represents the perpendicular, so that the correction is not to be considered as the difference of latitude between the two positions, where the observations are taken.

If the ship's course be altered after the first observation, or during the elapsed time, then, the course and distance made good must be used to find the angle and amount of correction.

To find the latitude and apparent time at ship.

Rule.—If a chronometer be used for noting the times of observation, make up its error and rate for each observation.

Find the half elapsed time, and the middle mean time at Greenwich between the observations.

Reduce the sun's declination, and the equation of time, (both from p. II. N.A.) to the middle mean time Greenwich.

Correct the altitudes, and reduce the first altitude for change of place if requisite, according to the preceding rules, (p. 184.)

Find half the sum and half the difference of the corrected altitudes.

Write out a form for the required quantities and their logs, from T. 5 according to the worked examples, by which means, the secant and sine of the declination, the cosine and sine of half sum, and the sine and cosine of half difference can be taken out together, and put into their respective places for adding up. Then,

(1.) To secant of sun's declination, add co-secant of half elapsed time, the sum is co-secant of *arc* 1.

(2.) To co-secant arc 1, add cosine of half sum of altitudes and sine of half difference of altitudes, the sum is sine of *arc* 2.

(3.) To secant of arc 1, add sine of half sum of altitudes, cosine of half difference of altitudes, and secant of arc 2, the sum is cosine of *arc* 3.

(4.) To sine of sun's declination, add secant of arc 1, the sum is cosine of *arc* 4; if latitude and declination, be one N. the other S. take the arc found in T. 5, from 180° for arc 4.

(5.) The difference of arcs 3 and 4, is arc 5, except when the latitude is less than the declination both N. or both S. then take the sum of arcs 3 and 4 for arc 5, which arc 5 must be less than 90°.*

---

* When the latitude thus obtained differs much from the latitude by account, arc 5 must be recomputed; viz. if the *difference* of arcs 3 and 4 were taken for arc 5, *now* take the *sum* of arcs 3 and 4 for arc 5, if the sum of 3 and 4 be less than 90°.

Again, if the *sum* of arcs 3 and 4 were taken for arc 5, *now* take the *difference* for arc 5, and proceed (by 6) to find another latitude.

(6.) To secant of arc 5, add secant of arc 2, (already found) the sum is co-secant of latitude.

(7.) To secant of latitude add sine of arc 2, (2.) the sum is sine of sun's hour angle at ship, corresponding to the middle mean time Greenwich, if P.M. the hour angle is apparent time; if A.M. subtract it from 24h for apparent time, to which apply the reduced equation of time as directed in the N.A. p. I, the result is mean time at ship, the difference between this and the middle mean time Greenwich, by chronometer, is the longitude of the ship.

Should the ship time of the first or second observation be required, the half elapsed time subtracted from, or added to, the middle time found by (7.) will give either.

Ex. 1.— 1852, February 2, P.M. at ship, the sun's true altitude was 62° 28′ bearing N.36°W. Greenwich mean time, by chronometer 2d 4h. 50m. the ship sailed N.36°W. 19′, when the sun's true altitude was 24° 59′ the Greenwich mean time 2d. 8h. 30m. latitude by account 40° 12′S. required the lat. and likewise the long. by chronometer.

1st. obs. - - -	4h	50m			
2nd ,, - - -	8	30			
elaps. time - -	3	40			
half el. time - -	1	50			
middle time - -	6	40			
1st true alt, - -	62°	28′			
for change of station	+	19			
	62	47			
2nd true alt - -	24	59			
sum - - - -	87	46	half sum	43°	53′
diff. - - - -	37	48	half diff.	18	54

☉'s dec. p.II. N.A.
16° 57′ 51″S.
− 4 50
16 53

☉'s bearing N. 36°W.
Course - N. 36°W.
add the whole distance } ∠0

diff. 43·44″
×6·40
260·64
21·72
7·24
6,0)28,9·6
4 49·6

equ. t.p.II.N,A.
13m 57·95
+ 1·94
r. eq.14

diff. 292
×6·40
1·752
·146
·048
1·946

half el.time	1h 50m	co-sec...	·33559				
dec,........	16°53′	sec......	·01913			sine	9·46303
arc 1........	26 13	co-sec.. .	·35472	sec. ..	·04715	sec......	·04715
half sum....	43 53	cos.	9·85778	sine...	9·84085		
half diff	18 54	sine	9·51043	cos. ..	9·97593		
arc 2........	31 54	sine	9·72293	sec .	·07110*		
arc 3........	30 34			cos. ..	9·93503		
arc 4........	71 7					...cos......	9·51018
arc 5........	40 33			sec. ..	·11928+*		
latitude.....	40 10	sec.	·11681	cosec. .	·19038		
h. ∠ ap.t. .	2h 55m 0s	sine.....	9·83974				
equ.time. .	+ 14 0						
mn.tm ship	3 9 0						
mn t.Grnw.	6 40 0						
	3 31 0	=long. 52° 45′ 00″W.					

2. 1852, May 12, A.M. at ship, the sun's true altitude was 41° 31′ bearing S.73°E. mean time Greenwich by chronometer, 11d. 23h.22m.7s. the ship sailed S.70° W.20′, when the sun's true altitude was 63° 3′; mean time Greenwich 12d. 2h. 28m. 7s. latitude by account 45° 7′N.; required the latitude, and the longitude by chronometer.

	d	h	m	s
1st obs. - -	11	23	22	7
2nd obs. - -	12	2	28	7
elapsed time - -		3	6	
half el. time - -		1	33	
mid time - -	12	0	55	7

⊙'s dec. p.II. N.A.
18° 14′ 41″N.
+ 34
18 15 15

diff. 37·06″
$\frac{1}{12}$ 3·08
34

⊙'s bearing	S. 73°E.
course -	S. 70 W.
∠	143
	180
with dist. 20′ &	37°
in T.2. cor.	—16

1st. true alt......	41°	31′
cor. for change ...	—	16
	41	15
2nd true alt.	63	3
sum............	104	18
diff............	21	48

eq. time p.II. N.A. diff. 0 36
3m 53·11s
3 53 — from ap. time

half sum 52° 9′
half diff. 10 54

half el. time	1h 33m	co-sec. ..	·40368				
dec.......	18° 15′	sec......	·02241			sine.. ..	9·49577
arc 1......	22 1	co-sec ..	·42609	sec. ..	·03288	sec......	·03288
half sum...	52 9	cos......	9·78788	sine...	9·89742		
half diff....	10 54	sine.....	9.27668	cos....	9·99209		
arc 2......	18 2	sine.....	9·49065	sec. ..	·02187*		
arc 3......	28 25			cos....	9·94426		
arc 4......	70 15½					cos.	9·52865
	41 50½			sec ...	·12785 + *		
latitude....	45 6	sec.......	·15127	co-sec. .	·14972		
h. ∠...	1h 44m 0s	sine	9·64192				
ap.t. ship	22 16 00						
equ. time	— 3 53						
mn.t ship	22 12 7						
mn t.Grn	24 55 7						
	2 43 0 — 40° 45′ 00″W. long.						

Examples for Exercise.

1.—1852, April 7, P.M. at ship, the sun's true altitude was 63° 22′ bearing S.34°W. mean time Greenwich by chronometer 6d. 16h. 17m. 10s. The ship sailed S.29′, when the sun's true altitude was 27° 19′; mean time Greenwich 6d. 19h. 29m. 8s. latitude by account 29° 16′N. required the latitude at the second observation, and longitude by chronometer.?

Answer.—Latitude - - - - 29° 18′ 30″N,
Long. by chronometer, 130 44 45 E.

2.—1852, January 3, A.M. at ship, the sun's true altitude was 37° 6′ bearing S. 109°E. mean time Greenwich by chronometer, 2d. 15h. 18m. 23s. The ship sailed S.19° E. 20′ when the sun's true altitude was 61° 26′, mean time Greenwich 2d. 17h. 58m. 27s. latitude by account 5° 3′N.; required the latitude at the second observation, and longitude by chronometer ?

Answer.—Latitude - - - - - - 5° 1′N.
Longitude by chronometer 85 31 E.

3.—1852, March 15, A.M. at ship, the sun's true altitude was 32° 46′ bearing N.63°E. the mean time Greenwich by chronometer 14d. 18h. 47m. 4s. The ship sailed S.63°W. 20′, when the sun's true altitude was 52° 44′, mean time Greenwich 14d. 21h. 27m. 2s. latitude by account 38° 20′S. required the latitude at the second observation and longitude by chronometer ?

Answer.—Latitude - - - - - - 38° 22′S.
Longitude by chronometer 31° 31′ 45″E.

By the above method the latitude may be determined from two altitudes of the same fixed star, with the elapsed time between the observations; it will however be necessary, if the interval be given in *solar* time to reduce it to *sidereal* time, which may be done with sufficient exactness by increasing the observed interval one second of time for every six minutes, or ten seconds for every hour.

To find the latitude by an altitude of the sun taken near the meridian, having the latitude by account, the apparent time of observation, and the longitude, given,

Situations frequently occur at sea in which the true determination of the latitude becomes an object of primary importance to the mariner; when, therefore in such cases, from the interposition of clouds, fogs, &c. the meridional altitude of the sun cannot be observed, the latitude may be obtained from the sun's altitude, taken at any interval from noon not exceeding the following limits, *viz.* the number of minutes and parts of a minute contained in the interval between the time of observation and noon, must not exceed the number of degrees and parts of a degree comprised in the sun's meridional zenith distance at the place of observation.

Now the sun's meridional zenith distance is expressed by the difference between his declination and the latitude of the place of observation when they are of the same name, or by their sum when they are of contrary names, the extent of the interval from noon, *within which the altitude should be observed*, may therefore be found by means of the difference between the latitude and the declination, when they are both north or both south: or by their sum when one is north and the other south; thus if the latitude be 71° and the declination be 23° both of the same name, the interval between the time of observation and noon, must not exceed 48 minutes; but if one be north and the other south the interval may be extended, if requisite, to 94 minutes before or after noon.

The sun's altitude being observed *at any time within the above mentioned limits*, the latitude of the place of observation may be determined to every necessary degree of accuracy, by the following

Rule.—From the observed altitude of the sun's upper or lower limb, find the true altitude of his centre. (page 168.)

Take the sun's declination from page I, of the month, in the Nautical Almanac, and reduce it to the apparent time of observation by Table 31, or by the hourly difference from the Nautical Almanac.

Add together,—
the log rising of the time from noon, (Table 30)
the log co-sine of the latitude, (Table 5)
and the log co-sine of the declination, (Table 5)

Find the natural number corresponding to the sum of these three logarithms, rejecting tens in the index, (Table 4.)

Add this number to the natural sine of the true altitude (Table 32;) taken out to 5 places, their sum will give the natural co-sine of the meridional zenith distance, to which apply the declination as before, and the result will be the latitude.

If the latitude found as above differ materially from the latitude by account, the operation may be repeated, using the former in the place of the latter.

If the time at ship when the altitude is observed be shewn by a watch, whose error for apparent time has been previously determined, this error must be applied to the time shewn by the watch at the time of observation, and should the ship have changed her longitude since the error of the watch was ascertained, this difference of longitude must be turned into time, and added to the corrected time shewn by the watch if east, or subtracted if west.

Or if the time be taken by a chronometer shewing mean time at Greenwich, it may be reduced to apparent time at Greenwich, by applying thereto the equation of time, taken from p. II, of the month, in the Nautical Almanac; to the apparent time at Greenwich add the longitude of the ship in time, if it be east, or subtract it if west, and the result will be the apparent time at ship.

Example.—1852, June 2, A.M. at ship, in latitude by account 35° 10′N. longitude 54° 30′W. the observed altitude of ⊙ was 76° 45′ index error + 9″, height of the eye 14 feet, time by watch 3h. 19m. 31s. its error on *apparent time* at ship, found previously (the same morning) 3h. 30m. fast; sailed to east, since error was found, 21′ diff. long.; required the latitude.

	h	m	s	
time by watch	3	19	31	
error, watch fast.........	3	30	0	
	23	49	31	
sailed E. 21′.......... =	+	1	24	
	23	50	55	
long. W. 54° 30′ ..... =	3	38	0	
Greenwich app. time......	3	28	55	P.M.

	°	′	″
⊙'s dec. app. noon, p.I. N.A.............	22°	15′	1·5″N
diff. 1h, 18·56″ × 3·29 =	+	1	4·6
⊙'s dec. time of obs.* ..	22	16	6N.

⊙'s hour ∠ = 9m. 5s east of meridian = 2° 16′ 15″ in arc.

⊙'s l.l 14 ft. + 9″ =	76°	45′	9″	-	hour ∠ 9m. 5s. log. ris.	2·89504†
cor. ⊙'s l.l. - - - -	+	11	55	-	⊙'s dec. 22° 16′ 6″ cos.	9·96634
true alt. - - - - -	76	57	4	nat. sin. 974177	lat. 35° 10′ cos.	9·91248
				594	nat. number.	2·77386
mer zen. dist.	12°	53′	51″N.	nat cos, 974771		
⊙'s declin....	22	16	6N.			
latitude.. ...	35	9	57N.			

Examples for Exercise.

1.—1852, July 5, P.M. at ship, latitude by account 15° 27′S. longitude 89° 30′W, the obs. alt. ⊙ 51° 20′, eye at 16 feet, time by watch 5h. 43m. 20s. its error on apparent time at ship found previously, 5h. 22m. 10s. fast; since the error was found the ship made 25′ diff. of long. to westward; required the latitude?

Answer.—15° 26′S.

2.—1852, August 12, A.M. at ship, lat. by account 39° 16′S. long. 156° 25′E. the obs. alt. ⊙ 34° 55′ eye at 12 feet, time by watch 13h. 41m. 25s. its error on apparent time at ship found previously, 9h. 41m. 8s. slow, since the error was found the ship made 33′ diff. of long. to eastward; required the latitude?

Answer.—39° 16′S.

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* The sun's declination, if corrected by the equation of second differences, would be 22° 16′ 7·6″

† When the *nat. sine* is used to 6 places, the index of *log rising* must be increased by 1, and when to 7 places, it must be increased by 2.

Another method.

Find the sun's *true* altitude, the sun's declination for the *apparent time* of observation as before, and convert the *apparent time from noon* into degrees, minutes, and seconds of arc, then add together the log co-sine of the sun's declination, the constant log. 5·01340, (which is the arith. compl. of the log. of 2 sin. 1″,) the log. co-sine of the approximate latitude, or latitude by account, the log. secant of the *true* altitude, and *twice* the log. sine of the hour angle from noon; the sum will be the log. of the number of seconds of arc which must be added to the *true* altitude, to give the *meridian* altitude of the sun; from which the latitude is found as before directed.

The great advantages of this method are, that it gives the whole correction by *one* operation, without taking out natural sines, or natural numbers, except the one natural number at the close of the operation, and that it requires no other tables than the ordinary ones of logs, sines, tangents, secants, &c.

The same directions and remarks as to *limits*, which have been given with respect to the first method, apply equally to this method.

Example 1, page 190, worked by the 2nd. method.

☉'s declin. - - - -	22° 16′ 6″	- - - cos.	9·96634
lat by account - - -	35 10 0	- - - cos.	9·91248
altitude - - - - -	76 57 4	- - - sec.	0·64631
arith. compl. - - - -	2 sin. 1″	- constant log.	5·01340
merid. dist. - - - -	2 16 15	- - - sin.	8·59795 }
		again - -	8·59795 }
correction - -	542·6″	nat. number =	2·73443
	9 ·3″		
zenith distance - - -	13 2 56		
mer. zenith distance -	12 53 53 N.		
☉'s declin. - - - -	22 16 6 N.		
latitude - - - -	35 9 59 N.		

A Third Method.

In which the sun's *azimuth* from the meridian is given instead of the hour from noon.

Rule.—Add together the log. secant of the declination, the constant log, 5·01340, the log. co-sine of the latitude by account, the log. co-sine of the true altitude, and the log. sine of the *azimuth,* twice taken as above; the sum as before will be the log. of the number of seconds of arc, to be added to the altitude at the time of observation, or subtracted from the zenith distance, to give the meridian altitude, or the meridian zenith distance.

In order to apply this method to the foregoing example, we shall compute the azimuth corresponding to the time, 9m. 5s. before noon, (see worked example, page 190.)

To compute the azimuth.

	°	′	″		
true zenith distance......	13	2	56	cosec.	0·646310
hour angle.............	2	16	15	sine	8·597949
declination.............	22	16	6	cos.	9 966339
azimuth...............	9	20	47	sine	9·210598

Then to find the correction of the zenith distance.

	°	′	″		
⊙'s declination........	22	16	6	sec.	0·03366
arith. compl. log. 2 sine 1″				constant log.	5·01340
latitude by account....	35	10	0	cos.	9·91248
altitude...............	76	57	4	cos.	9·35369
azimuth..............	9	20	47	sine	9·21060
				again...........	9·21060
correction........ 542·6″				nat. number...... log	2·73443

	°	′	″
		9	·3
zenith dist.....	13	2	56
merid. zen. dist.	12	53	53N.
⊙'s declin.....	22	16	6N.
latitude.......	35	9	59N. same as before.

This method will be found useful, when the apparent time from noon is uncertain, the sun's altitude and azimuth being taken at the same time, either by the same observer, or by two different observers; and although one observer cannot take the altitude and azimuth at the same instant, yet his observations, as well as their results, are more likely to be consistent among themselves, than those of different observers, with one another. Besides, as a small error, either in the azimuth, or in the time from noon, will scarcely affect the resulting latitude, the azimuth may be taken a *minute*, or even *two minutes*, after taking the altitude, without producing any material error in the latitude.

Ex. 2.—On the 22nd. of January, 1852, in lat. 48° 30′N. and long. 5° 15′W. by account, the altitude of the sun's lower limb was found to be 20° 55′, when his azimuth, corrected for variation, was S. by W. or S. 11° 15′W.; required the *true* meridian altitude, the *true* latitude, and the *time* at ship, the height of the observer's eye being 26 feet, above the level of the sea?

	°	′	″
observed altitude of ⊙'s l.l.............	20	55	0
height of eye, 26 feet, dip, Table 8	—	4	52
app. alt. of ⊙'s l. l.	20	50	8
refraction — parallax	—	2	20
true alt. of ⊙'s l.l..................	20	47	48
⊙'s semidiameter, (N.A.)............	+	16	16
true alt. of ⊙'s centre	21	4	4

The time corresponding to the azimuth 11° 15′ will be

app. time at ship	0h	44m	37·3s	P.M.
difference of longitude = 5° 15′ W. . =		+21	0·0	
the sum is the Greenw. app. time of obs. =	1	5	37·3	P.M.
the ⊙'s declin. for this time is	19°	47′	11·8″S	

To compute the apparent time at ship.

As	cos. declin. 19° 47′ 12″ (sec.)	0·026429
:	sine obs. az. 11 15 0 (S.byW.)	9·290236
::	cos. true alt. 21 4 4	9·969954
	h. m. s.	
:	sine hour ∠ 11 9 20	9·286619

To find the meridian altitude and the latitude.

By the first method,

app. t. from noon, at ship, 22 Jan. 1852 = 44m 37·3s.						log rising..	4·27613
latitude by account	48°	30′	0″N.			cos.	9·82127
sun's declin.	19	47	12 S.			cos.	9·97357
				nat. number	11775	log...	4·07097
sun's true alt.	21	4	4	nat sine....	359492		
mer true zen. dist.	68	12	22N.	nat. cos....	371267		
sun's declin.	19	47	12 S.				
latitude	48	25	10 N.				

If this operation be repeated, substituting the cosine of 48° 25′ 10″ for cosine 48° 30′ above, the resulting *corrected* latitude will be 48°25′6″N. and will be exceedingly near the *true* latitude, as would appear evident were the computation made upon the strict principles of Spherical Trigonometry, and independently of any *assumed* latitude, or latitude by account.

By the second and third methods,

second method (*app. time given,*) *third method* (*azim. given,*)

⊙'s declin.	19°	47′	12″S.	cos.	9·97357		sec.	0·02643
arith. comp. log. 2 sin. 1″					5·01340			5·01340
lat. by account	48°	30′	0″N.	cos.	9·82127		cos.	9·82127
true alt.	21	4	4	sec.	0·03005		cos.	9·96995
hour ∠ 44m 37·3s –	11	9	20	sine	9·28662	az. 11° 15′	sin.	9·29024
			again	sine	9·28662	again	sine	9 29024
nat. number		2579·4		log.	3·41153	num. 2579·4″	log.	3·41153

correction	=	42′	59″
⊙'s zen. dist.	68	55	56
merid. zen, dist	68	12	57 N.
⊙'s declin.	19	47	12 S.
latitude	48	25	45 N.

correction	=	42″	59″
⊙'s zen. dist.	68	55	56
merid, zen: dist.	68	12	57N.
⊙'s declin.	19	47	12S.
latitude	48	25	45N.

These two methods will be identical, and will be a check upon one another, whenever the *time* is *correctly* computed from the *azimuth*, or the *azimuth* from the *time*, as in the present instance. But when both are otherwise determined, and independently of each other, the latitudes resulting from them will probably seldom agree; but the proximity to coincidence, or the non-agreement of the results will always be a sufficient test of the quality of the observations, and the accuracy of calculation.

Example for Exercise.

1852; Oct. 12, in longitude 4° 40′W. and latitude by account 54° 9′N. the apparent zenith distance of *a* Aurigæ, (Capella) near the meridian was 8° 18′ 39″N. when the barometer stood at 28·73 inches, and the thermometer at 47° 00′: the azimuthal deviation of the plane of the instrument from the meridian, being 1° 57′; required the latitude, and the place of observation?

Answer,—latitude, 54° 8′ 57″N.
Place, South Barule, Isle of Man.

ON FINDING THE TIMES AND LONGITUDE.

BY OBSERVATION.

It has been already remarked that the interval of time between two successive transits of the sun over the meridian of any place, is called a natural day, being in fact the time in which, by the rotation of the earth from west to east on its axis, any particular meridian is turned round from the sun to the sun again; and since this revolution is performed at a mean rate in twenty-four hours, (which is therefore the length of what is called a *mean solar day*) and the equator is divided into 360°, it follows that there must be a revolution of 15° of the equator in one hour of time, of 1° in four minutes of time, and so on.

It is noon to all places on the meridian of Greenwich, when that meridian is brought immediately under the sun, at which instant it will be an hour past noon or 1h. P.M. at all places on the meridian 15° to the east of that of Greenwich, and it will want an hour to noon, or be 11h. A.M. at all places on the meridian 15° to the west of it; *the time at any place being determined by the sun's arrival at the meridian of that place.*

If the difference of time between any two places be ascertained, their difference of longitude is found by converting this difference of time into degrees, minutes, &c. reckoning 15° of longitude to an hour, and proportionally for minutes, seconds, &c. of time,

The practical methods principally resorted to for ascertaining the difference of time, and thence the longitude, are the following:

By a Chronometer. If a chronometer be truly regulated to mean solar time, and set to the mean time at Greenwich, it will show Greenwich time in all places to which it is carried, and the time at any distant place of which the longitude is sought, may be found by observing the time of the sun's passing the meridian, to which the equation of time being applied, will give twelve o'clock, or noon, at that place,

By comparing the mean time at the place, found by this or any other method proper for the purpose, with the time shewn by the chronometer, the longitude of the place in time, will appear as the error of the chronometer on the former time; and this apparent error turned into degrees, minutes and seconds, will be the longitude sought, *west* if the chronometer appear *fast*, but east if it appear *slow* for the time at that place.

Could a chronometer be made which, under every change of climate, and other causes of derangement to which such instruments are liable, might still be depended upon for shewing correct time, this mode of determining the longitude, would, from its extreme facility, supersede all others; but, notwithstanding the great improvements that have been made in these complicated pieces of mechanism—the chronometer, although it may preserve its uniformity of rate during a few hours or even days, still remains too imperfect an instrument to be implicitly relied on in long voyages, and other methods have accordingly been resorted to, for ascertaining the difference of time at two distant stations.

Most of these methods are purely astronomical, and depend upon having the exact times of all the most remarkable celestial phenomena for every day in the year, calculated for the meridian of Greenwich, and set down in the Nautical Almanac, which is published several years in advance for the benefit of ships going long voyages.

If, when one of these phenomena is observed at a distant place, the time at that place be determined by observation or otherwise, the difference between the latter time and that at which the same phenomenon was calculated to take place at Greenwich and set down in the Nautical Almanac, will also be known, and consequently the longitude may be easily found.

The celestial phenomena, proper for determining the longitude are the eclipses of Jupiter's satellites, the eclipses of the moon, the moon's place in the zodiac, and the moon's distance from the sun, a planet or certain fixed stars, which, from their use in determining the longitude at sea, are sometimes called nautical stars.*

The eclipses of Jupiter's satellites are in some respects preferable to those of the moon for finding the longitude, being less subject to parallaxes, and as they are of very frequent occurrence, and are easily observed, they are much used for this purpose on shore, but are not available at sea, from their being entirely telescopic phenomena, requiring the application of instruments of much higher magnifying powers, than can be employed on board ship.

Eclipses of the moon occur too seldom to be of much general use in determining the longitude, and as the beginning or end of an eclipse of the moon, by reason of the penumbra which bounds the earth's shadow, cannot commonly be ascertained nearer than one, and sometimes two or even three minutes of time, the results to be obtained from them can only be regarded as approximations to the truth.

The moon's place in the zodiac, although a phenomenon more frequently to be observed than her eclipses, yet by reason of two parallaxes, the calculus becomes too perplexed and intricate to be generally practicable.

The moon's distances from the sun, the planets, and certain fixed stars are phenomena which seem to be more available for the determination of the longitude, than any others that have hitherto been employed for that purpose. The Nautical Almanac gives the angular distance of the moon's centre from that of the sun, and from the other celestial bodies above mentioned, for every third hour of Greenwich mean time, as they would appear to an observer at the centre of the earth.

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* The *stars* used for this purpose are Aldebaran, Antares, αAquilæ, Arietis, Fomalhaut, αPegasi, Pollux, Regulus, and Spica Virginis. The planets whose distances from the moon are computed, are *Venus*, *Mars*, *Jupiter*, and *Saturn*.

When a lunar distance has been observed at any distant place, and reduced to the centre by clearing it of refraction and parallax, the Nautical Almanac enables us, by a simple process, to find the exact Greenwich mean time, when the objects would have the same distance; and the interval between the Greenwich time, and the time at the place of observation, is the longitude in time of that place, which may be turned into degrees, &c. as before directed.

Since the parallax and refraction of celestial objects vary with the altitude of those objects, the moon's altitude, as seen from the centre, being *greater,* and that of any other celestial body *less,* than as seen from the surface of the earth, it is obvious that before the true distance can be computed, the *altitudes* of the objects as well as their *apparent distance,* must be known.

Therefore, in taking what is technically called a *lunar observation,* the altitudes and distances of the objects, are generally measured at the same instant by different observers, while an assistant notes by a watch, the time at which the observations are taken.

A very skilful observer may indeed himself obtain both the altitudes and distance, by taking the altitudes of the objects both before and after measuring the distance, noting carefully the time of each observation and then computing by proportion, from the change of the altitudes, what they must have been at the time of observing the distance; this method, however, ought certainly not to be adopted, when a sufficient number of competent observers is to be had.

It is a very general practice, though not in all cases to be recommended, to take several sets of observations, and make use of a mean of the whole as a single observation,

From what has now been stated it will be seen that two things, perfectly distinct in themselves, are essential in order to obtain the true longitude. The first is, *to find the time at ship, or at any proposed meridian,* and the second is, *to find the time at the same instant at Greenwich;* the former of these is found at sea, from the observed altitude of the sun, a star, or any other proper celestial object, and the latter by means of a chronometer, or by the distance of the moon from the sun, a fixed star, &c.

In altitudes used only for determining the true distance, great accuracy is not requisite, but altitudes employed for *computing the time,* cannot be taken with too much precision; great care is also necessary in measuring the distance, in which an error of 1′ will commonly produce a mistake of 2m. of time, or about ½ a degree in the longitude deduced from it.

FINDING THE TIME AT SHIP OR ANY GIVEN MERIDIAN.

To find the apparent and mean time at ship or place of observation and thence to deduce the error of the watch or chronometer by an altitude of the sun, having the latitude of the place, and the estimated time and longitude given.

Rule,—From the observed altitude of the sun's lower limb subtract the dip (T. 8) and the correction of the sun's apparent altitude, (T. 13) To the remainder add the sun's semidiameter taken from p. II. of the month in the Nautical Almanac, the sum will be the true altitude of the sun's centre.* (page 168)

With the estimated mean time and longitude, find the corresponding time at Greenwich, by the rule already given for that purpose, in page 160.—Or,

The Greenwich mean time may be found by a chronometer whose error for that meridian is known.

From p. II. of the month in the Nautical Almanac, take out the sun's declination for the preceding noon, and correct it for Greenwich mean time by T. 31, or by the difference for 1 hour, taken from p. I. of the month, in the Nautical Almanac.

If the latitude and declination are of the same name, subtract the latter from 90°, but add it to 90° if they are of contrary names,—the sum or remainder will be the sun's polar distance.

Take out the equation of time from page II. of the month, in the Nautical Almanac, and reduce it to Greenwich time by the difference for 1 hour, taken from the column in page I. Then proceed as follows:

Add together the sun's true altitude; his polar distance and the latitude of the place of observation. Take half the sum and find the difference between this half sum and the sun's true altitude, and call it the *remainder*.

Then add together— The co-secant of the polar distance.
The secant of the latitude.
The co-sine of the half sum.
The sine of the remainder,

The sum of these four logarithms, rejecting tens in the index, will be the log. (T. 33.) answering to the sun's distance from the meridian, or to the *apparent time* from the *nearest* noon, which will therefore be the apparent time at ship, if the observation be made in the afternoon; but if in the forenoon, its complement to 24 hours will be the apparent time from the *preceding* noon.

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* The correction for dip, refraction, and semidiameter, may be taken at once, (but with less accuracy,) from T. 14. See, however, the observation immediately preceding the rule for finding the time.

To the apparent time thus found, apply the reduced equation of time by addition or subtraction as directed at the head of its column in the Nautical Almanac, and the sum or remainder will be the *mean time*, at the ship or place of observation. Thus, the error of the watch or chronometer at the meridian of the ship or place, may be found either for apparent or mean time.

1. If several altitudes of the sun's limb be taken, and the corresponding times per watch, be duly noted, then the sum of the altitudes and that of the times being each divided by the number of observations, will give the *mean* of the altitudes and of the times.

As the computed time will be least affected by any error in the observation, when the azimuth at the time of taking the altitudes is 90° the sun or object, whose altitude is taken for the time, should be as near the east or west as possible, and should at any rate be considerably distant from the meridian.

Example 1.—1852, September 30, A.M. at ship, in latitude 41° 15′S. with the following altitudes, $\underline{\odot}$, eye at 15 feet, and times by chronometer, its error for mean time Greenwich, 38m 36s. fast; required the mean time at ship, and error of chronometer for apparent time at ship?

times by chron.	29d	10h	7m	29s
			7	58
			8	33
	3)	30	24	00
the mean.		10	8	0
error, fast		—	38	36
mean time Greenwich	29	9	29	24

obs. alt. ☉'s l l.	28°	12′	20″
		16	10
		20	30
3)		49	00
the mean	28	16	20
dip, T. 8.	—	3	42
	28	12	38
cor. T.13	—	1	38
	28	11	0
semidiam. N.A.	+	16	
true alt.	28	27	

Eq. time, N. A. p II.		9m 48·61s	
diff. ·811 × 9½h.	+	7·7	
red. eq. time.	—	9	56

☉'s dec. p. II N.A.	2°	34′	25″
diff. 1h. 58 36″ × 9½h ...	+	9	14
	2	43	39
	90		
polar distance.	87	16	

☉'s true alt.	28	27		
polar distance.	87	16	cosec. ...	·00049
latitude.	41	15	sec. ...	·12388
sum	156	58		
half sum.	78	29	cos	9·30028
remainder	50	2	sine. ...	9·88447

log. T. 53, hour ∠ east	3h	34m	40s	9·30912
app. time ship	20	25	20	
chron.	10	8	0	
chron. slow app. time ship...	10	17	20	

ap. t. ship	20	25	20
eq. time.	—	9	56
mean time ship	20	15	24

Ex. 2.—1852, October 25, P.M. at ship, in latitude 15° 35′N. with the following altitudes of the ⊙, eye at 15, and times by chronometer, its error for mean time Greenwich being 23m. 30s. slow, required the mean time at ship, and error of chronometer for apparent time at ship.

	h	m	s
times by chron	5	40	46
		41	18
		41	41
3)	17	3	45
the mean.	5	41	15
error, slow	+	23	30
mean time Greenwich.	6	4	45

equ. time, p.II, N.A. ...	15m 51·08s
diff. ·253 × 6h.5m........	+ 1·52
red. equa. time........ —	15 53

⊙'s dec. p.II..........	12°	15′	51″S.
diff. 51·34″ × 6h.5m. . =	+	5	12
red. dec...............	12	21	
	90		
polar distance	102	21	

obs. alt· ⊙'s l. l.........	33°	9′	45″
	33	5	0
	33	0	0
3)	99	14	45
the mean	33	4	55
dip, T. 8	—	3	42
	33	1	13
sun's cor. T.13.	—	1	20
	32	59	53
semidiam. p. II, N.A....	+	16	7
true alt................	33	16	

⊙'s true alt.	33	16		
polar distance	102	21	cosec...	·01017
latitude.............	15	35	sec. ...	·01626
sum	151	12		
half sum............	75	36	cos. ...	9·39566
remainder...........	42	20	sine....	9·82830

	h	m	s				h	m	s
ap.time ship, P.M.	3h	19m	38s	log T. 33,		9·25039 .... =	3h	19m	38s
time by chron....	5	41	15			red. equa. time...	—	15	53
chr.fast on ap.t.ship	2	21	37			mean time ship ..	3	3	45

Examples for Exercise.

1.—May 14, (civil time) 1852, being A.M. at ship, in latitude 43° 40′N. the observed altitude of ⊙ being 38° 59′ 40″, index error 2′ 10″ to add, height of eye 17 feet, time by chronometer 5h. 15m. 30s. P.M. the chronometer was 1h. 38m. 50s. slow for mean time at Greenwich, on March 25, at noon, and gaining daily 6·25s.; required the apparent and mean time at ship?

Answer.—Apparent time 20h 26m 59s
mean time 20 23 5
chronometer fast for mean time at ship 10 26 1

2.—March 12, 1852, P.M. at ship, latitude 48°48′S. the mean of several observed altitudes of ⊙ 16° 40′ 40″— index error 3′ 10″, eye 18 feet, mean of times by chronometer 23h. 50m. 25s. March 11, the chronometer was 10m. 10·25s. slow for mean time at Greenwich, on the noon of February 2, and gaining daily 3·75s.; required apparent and mean time at ship, as well as the error of chronometer for mean time at ship.

Answer.—Apparent time at ship 4h 30m 56s P.M.
mean time at ship 4 40 47 P.M.
chronometer slow for mean time at ship 4 42 38

TIME BY FIXED STARS, PLANETS OR MOON.

To find the mean time at ship or place of observation, and thence the error of the chronometer, by an altitude of a fixed star, planet or the moon, having the error of the chronometer on Greenwich mean time given, together with the latitude of the place.

Rule.—With the given time by chronometer, find the mean time at Greenwich, as before directed, and apply the index error, to the observed altitudes.

For a star,—from the observed altitude subtract the dip, Table 8, and refraction, Table 7, the remainder will be the star's true altitude.

For a planet,—proceed as for the sun, page 174.

For the moon,—from the observed altitude subtract the dip, then if the lower limb is observed, add the augmented semidiameter taken from the N.A. but if the upper limb, subtract it. With the horizontal parallax found in the N.A. find the correction in Table 24, and add it to the apparent altitude.

From page ii of the month in the Nautical Almanac take out the sun's mean right ascension, (which at mean noon is the same as the sidereal time) and reduce it to Greenwich time, by the constant differences in Table 43, taken from the N A.

From the N.A. take the right ascension and declination of the given heavenly body, and with the declination find its polar distance.

The right ascension and declination of the star may be taken from Table 12, and reduced to the given year and month.

By the rule given in the preceding problem find the hour angle, or distance from the meridian, of the object.

Then, if the heavenly body be west of the meridian, *add* together its hour angle and right ascension, but *subtract* the hour angle, if east of the meridian; the sum or remainder will be the sidereal time at ship, formerly called the right ascension of the meridian.

From the sidereal time at ship, increased by 24h. if necessary, subtract the sun's reduced mean right ascension, and the remainder will be the mean time at ship; whence is deduced the error of the chronometer, as before.

Example 1.—1852, February 7, P.M. at ship, in latitude 38° 40N. with the observed altitude, ☾ east of meridian 30° 51′ index error—12″, eye at 14 feet, time by chronometer 7d. 15h, 18m. 50s, its error for mean time Greenwich 15m. 10s. slow; required the mean time at ship, and the error of chronometer for mean time at ship.

	d	h	m	s
time by chron.........	7	15	18	50
slow for mean time Grnw.	+		15	10
mean time Greenwich ..	7	15	34	

☾'s semd. midn.	16′ 28 ·7″	h.p. 60′ 28″
cor. for 3h 34m ..	— 3	— 1
	16 28	60 27
aug. T. 22.	+ 8	
red. semd	16 36	

☾'s dec. 15h.	7°	55′	14″N.
diff. 133 ·88″ × 34m.	—	7	35
red. dec.	7	47	39
	90		
polar distance.	82	12	

sid. t. N.A.	21h	7m	5s
acc. on M. T. Greenwich.	+	2	33
red. s. t. N.A.	21	9	38

☾'s r. a. 15h.	11h	33m	50s
diff. 1h. 139 ·79s × 34m....	+	1	19
☾'s red. r.a.	11	35	9
hour ∠ E..	3	40	1
s. t. s. + 24h.	7	55	8
red. s. t. N.A.	21	9	38
mean time ship	10	45	30
chronometer.	15	18	50
fast for mean time ship	4	33	20

obs. alt. ☾'s l.l.		30°	51′	00″
index error .. . —	12	—	3	48
dip. T. 14. 3	36			
		30	47	12
red. semidiam.		+	16	36
app. alt.		31	3	48
cor. Table 24.		+	50	12

true alt.	31	54		
polar distance...	82	12	cosec. ...	·00404
Latitude	38	40	sec.	·10746
sum.	152	46		
half sum	76	23	cos. ...	9 ·37185
remainder	44	29	sine. ...	9 ·84553
log. hour ∠ T.33.	3h	40m 1s		9 ·32888

Example 2.—1852, December 7, A.M. at ship, in latitude 44° 48′S. with the observed altitude of Aldebaran west of meridian 34° 20′, index error +20″, eye at 17 feet, time by chronometer 6d, 16h. 4m. 22s. its error for mean time Greenwich 43m. 22s. fast; required the mean time at ship, and the error of chronometer on mean time at ship.

	d	h	m	s
time by chron.	6	16	4	22
fast for mean time Grnw..	—		43	22
mean time Greenwich ..	6	15	21	

s. t. p. II. N.A.	17h	1m	41s
acc. mean time Greenwich	+	2	31
red. s. t. N.A.	17	4	12

✱ dec. N.A. p.448	16°	12′	34″
	90		
polar distance...........	106	13	

✱'s right ascen. N.A.	4h	27m	29s
hour ∠ West............	2	34	56
s. t, s. + 24h.	7	2	25
red s. t. N.A.............	17	4	12
mean time ship..........	13	58	13
chron.	16	4	22
error, chron. fast........	2	6	9

✱ obs. alt. + 20″.........	34	20	20		
dip, Table 8 17 ft.......	–	3	57		
	34	16	23		
✱'s cor. Table 7	—	1	23		
✱'s true alt	34	15			
polar distance...	106	13		cosec....	·01763
latitude........	24	48		sec......	·04202
sum............	165	16			
half sum.......	82	38		cos......	9·10795
remainder......	48	23		sine.....	9·87367
✱'s hour ∠ West....	2h 34m 56s (T.33)			log......	9·04127

Examples for Exercise.

1.—1852, November 30, P.M. at ship, in latitude 48° 9′S. with the observed altitude of Sirius east of meridian 34° 19′, index error —10″, eye at 13 feet, time by chronometer 30d. 5h. 40m. 41s. its error for mean time Greenwich 13m. 19s. slow ; required the mean time at ship, and the error of chronometer for mean time at ship?

Answer,—Mean time at ship 10h. 12m. 42s.
error of chronometer, 4 32 1 slow

2.—1852, January 27, A.M. at ship, in latitude 42° 11′N. with the observed altitude of Mars west of meridian 45° 29′, index error +18″, eye at 22 feet, time by chronometer 27d. 1h. 42m. 18s. its error for mean time Greenwich 20m 18s. fast; required the mean time at ship, and the error of chronometer for mean time at ship.

Answer.—Mean time at ship, 26d. 15h. 19m. 20s.
error of chronometer 10 22 58 fast.

To find the mean time at ship by the altitude of a planet, independent of right ascension and equation of time.

RULE.—Reduce the declination and meridian passage of the planet to the meridian of the ship, and find its polar distance, then with the planet's true altitude, polar distance and the latitude in, find its distance from the meridian; then say, as 24h. is to the daily difference of the planet's meridional passage, so is the hour angle, to a correction, to be added to the hour angle, if the planet is receding from the meridian, but subtracted from it, if the planet is approaching the meridian; and the sum or difference will give the mean time from the meridian; hence the mean time of observation is known.

The sum of the meridional distance and the meridional passage at ship, will be the mean time of observation, when the planet is west of the meridian, but their difference, when it is east of the meridian.

TO FIND THE ERROR OF A WATCH OR CHRONOMETER.

By equal altitudes of the sun.

In the morning, when the sun is as nearly as possible in the prime vertical, or in any case when he is not less than two or three hours distance from the meridian, let several altitudes of his upper or lower limb be taken, noting the corresponding times (per watch) *since the preceding noon.* In the afternoon of the same day, observe the instant when the same limb of the sun, which was taken in the morning, comes to the same altitudes, writing down each time, opposite to its respective altitude, observing that the afternoon times are to be reckoned from the noon of the *same date* as those taken in the morning.

Take the means of the morning and of the afternoon times, add them together, and half their sum will be the middle time between the observations, or approximate time of noon per watch; take also their difference, which will be the interval of time between the observations.

The *Equation of Equal Altitudes* is a correction for the change of the sun's declination, to be applied to the middle time between the instants, at which the sun, as shown by a chronometer on any given day, has equal altitudes, in order to find by the chronometer when he is upon the meridian. To compute this correction observe the following

RULE.—To the co-tangent of the latitude add the co-sine of half the interval (in degrees &c.) between the times of observation, and the sum, rejecting ten from the index, will be the tangent of *arc first,* the difference between which and the polar distance, (found as usual from the latitude of the place and the sun's declination,) will be *arc second.*

Then add together—

The co-tangent of the same half interval.
The co-secant of arc first,
The co-secant of the polar distance,

The sine of arc second,
and
The log. of one-thirtieth of the seconds in the sun's change of declination, in the interval between the observations.

The sum of these logs. rejecting the tens from the index, will be the logarithm of the seconds of time, in the equation of equal altitud[illegible]

Having computed the equation of equal altitudes, add it to the middle time, if the polar distance is increasing, but subtract it from that time if decreasing, and the result will be the time shown by the watch or chronometer, at apparent noon, and the difference between that time and twenty-four hours, will be the error of the chronometer for apparent time, at the place of observation.

To find its error for mean time, either at the place of observation, or at Greenwich, reduce the equation of time to the given meridian: then add it to, or subtract it from twenty-four hours, as directed at the head of its column in the Nautical Almanac, and the result will be the *mean time* when it is apparent noon at the place of observation, to which apply the longitude of the place in time, adding it if west, and subtracting it if east, and the result will be the mean time at Greenwich, when it is apparent noon at the given place. Hence the difference between the middle time, corrected for the equation of equal altitudes, and the mean time at the place when it is apparent noon, will be the error of the chronometer for mean time at the place of observation.

In taking out the logarithms, from the sum of which the final result is obtained, four places of decimals only are required; neither is it requisite that the latitude of the place, or the value of the sun's declination be very accurately determined, as these elements are only employed in obtaining the polar distance, which may be deduced from the *declination to the nearest noon,* without producing any error of consequence.

Though altitudes taken by means of the marine horizon, are generally sufficiently correct for finding the longitude at sea, yet, owing to the effect of atmospherical haze, &c. upon the sea horizon, whereby it frequently becomes broken or ill defined, such altitudes are commonly subject to some degree of uncertainty, which renders them unfit for ascertaining the *error* of a watch or chronometer, for this purpose therefore the observations ought always to be made on shore, where the altitudes may be taken with a sextant by means of an artificial horizon, and the corresponding times ascertained with the greatest exactness; and in taking equal altitudes of the sun, it will be advisable for the observer, to fix the index of his sextant to some particular division on the arc, and then wait till the contact of the images takes place.

Example.—1852, April 20, in latitude 32° 22′N. longitude 64° 33′W required the error of chronometer for mean noon, the sun having equal altitudes A.M. and P.M. with the following times by chronometer.

A.M.	0h 51m 42s	☉'s red. dec.	11° 41′N	diff. 1h. N.A.	50·96″
P.M.	7 12 18	polar distance	78 19		× 6·20
Interval	6 20 36	red equ. time	1m 15s		305·76
		— from app. time			16·98
half	3 10 18			3,0)	32,2
middle time	4 2 0				10·7
latitude	32° 22′	cotan.	·1980		
half interval	47 34	cos.	9·8291	cotan.	9·9610
arc 1	46 47	tan.	10·0271	cosec.	0·1374
polar distance	78 19			cosec.	0·0091
arc 2	31 32			sine	9·7185
$\frac{1}{30}$ change dec	10·7			log.	1·0294
equ. equal altitudes	— 7s	p. d. dec^{s}		log.	=0·8554
middle time	4h 2 0				
chron. fast	4 1 53	for app. noon			24h 0m 0s
		equation of time			— 1 15
		mean time at app. noon			23 58 45
		chronometer + 24h			28 1 53
		chronometer fast for mean noon			4 3 8

Examples for Exercise.

1.—March 9, 1852, in latitude 36° 24′S. and longitude 56° 32′W. the mean of several times shewn by a chronometer, when corresponding altitudes of the sun's lower limb were taken in the morning, was 8h. 42m. 9s. and the mean of the times corresponding to the same altitudes taken in the afternoon, was 3h. 17m. 18s.; required the error of chronometer for mean noon at place of observation?

Answer.—Chronometer slow for mean noon, 0h. 10m. 41s.

2.—December 6, 1852, civil time, in latitude 48° 12′N. and longitude 72° 43′E. the mean of several times shewn by a chronometer, when corresponding altitudes of the sun's lower limb were observed in the morning was 22h. 50m. 13s. and the mean of the times corresponding to the same altitudes, taken in the afternoon, was 2h. 57m. 31s,: required the error of the chronometer for mean noon at the place of observation.

Answer.—Chronometer fast for mean noon, 1h. 2m. 27s.

It is sometimes found convenient to take equal altitudes, in the afternoon and in the following morning, in which case, the mean of the times will be the time of the intermediate midnight, or instant per watch (uncorrected) when the opposite meridian was directed to the sun, to this time, therefore, the equation of equal altitudes is to be applied with a *contrary* sign.

ON FINDING THE RATES OF CHRONOMETERS

If the errors of a chronometer be found as above, at a given place, on different days, sufficiently distant from each other, its daily rate may thence be readily deduced upon the assumption of an uniform motion, during the intervening period; thus, if the chronometer be found too fast at the time of observation, and the error increasing, the instrument will obviously be gaining on mean time, but if decreasing it will be losing on mean time.

If the chronometer be too slow at the time of the first observation, and the error increasing, the instrument will be losing on mean time, but if decreasing it will be gaining on mean time; for instance, if on a given day a chronometer be 14s. fast, and at the end of 15 days 60·5s. fast on mean time at any place, it has evidently gained 46·5s. in 15 days, or its rate is about 3·1s. per day gaining.

Suppose on a given day, a chronometer is found, by observation, to be 25s. fast, and at the end of 10 d. 20s. slow, its daily rate is 4·5s. losing. Hence the rate of a chronometer, is the quotient of the total gain or loss of the instrument, during the interval between observations, divided by the number of days, of which the interval consists.

Observations for the purpose of determining the rate of the chronometer, in order to prove the regularity of its going, should be made as often as convenient, for which purpose the following is a very easy method.

To find the rate of a chronometer, without reference to its error, by equal altitudes of the same fixed star, observed at the same place, and on the same side of the meridian, on different nights.

RULE.—Multiply 3′ 55″·91* by the number of days between the observations, and subtract the product from the time of the first observation; divide the difference between the remainder and the time of the last observation, by the number of days, and the quotient is the rate, *gaining*, if the remainder be *less* than the time of the last observation, but *losing* if *more*.

Example.—Suppose on May 4, at 10h. 15m. 26s. and on May 12, at 9h. 43m. 38s. a star on the same side of the meridian had equal altitudes; required the rate of the chronometer.

	10^h	15^m	26^s	first observation
3′ 55″·91 × 8 days =		31	27·28	reduction
	9	43	58·72	remainder
	9	43	38	second observation
		8)	20·72	
			2·59	losing daily

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* The daily acceleration of the Fixed Stars on mean time.

TO FIND THE LONGITUDE,

BY CHRONOMETERS.

The preceding rules for finding the time at ship, and the error and rate of a chronometer being thoroughly understood, will render the method of determining the longitude by that instrument, according to the following directions, a matter of little or no difficulty.

Rule.—Let an altitude, or rather let several altitudes of the sun or other celestial object be observed when it bears as nearly east or west as possible, but certainly not less than three hours distant from the meridian, noting down by chronometer the corresponding times; of these altitudes and times, take the means respectively.

To the mean of the times of observation, apply the *original error* of the chronometer, by addition or subtraction, according as it was slow or fast for mean time at the meridian of Greenwich, or of the place where its rate was last ascertained.

Multiply the *daily rate* by the number of days, and parts of a day that have elapsed since the error was last determined, and add the product, (which may be called the *accumulated error,*) to the above corrected time, if the chronometer was losing, but subtract it, if it was gaining, the result will be the mean time for the meridian of the place at which the original error and rate were last found.

If the meridian be any other than that of Greenwich, then add the longitude of the place in time, if it be west, but subtract it if east, and the sum or remainder will be the mean time at Greenwich, by the chronometer.

Take out the equation of time for the preceding noon, from page II of the month, in the Nautical Almanac, and the sun's declination, from page II of the same, and reduce them to Greenwich time, also from the latter, find the sun's polar distance.

Then with the true altitude of the celestial object, the polar distance, and the latitude of the place of observation, find the mean time at that place by the rules already given for that purpose; the difference between which and the mean-time at Greenwich, will be the longitude of the ship or place of observation in time, *east* if the time at the place of observation be greater than the time at Greenwich, but *west* if it be less.

Example 1.—November 9, 1852, A.M. at ship, in latitude 10° 6′N.

with the following observed altitudes ☉ at 10 feet, and times by chronometer, slow 22m. 19s. for mean time Greenwich, July 31st, and gaining daily 4·8s.; required the longitude.

times by chron.	8d	16h	12m	17s
			12	42
			13	13
3)			38	12
mean of times	8	16	12	44
slow, July 31	+		22	19
		16	35	3
100 d. × 4s. 8 p. p. for 16h. = 3s.		—	8	3
mean time Greenwich	8	16	27	
before noon of 9th		7	33	
equa. time N.A. p.II.		15	58	87
diff. ·221 × 7·33		+	1	70
red. equa. time		16		

☉'s l.l.	37°	3′	0″
		6	50
		11	10
3)		21	
mean of alts	37	7	
dip. 3′2″ cor. (T.13) 1′ 9″	—	4	11
	37	2	49
semd. N.A.	+	16	11
true alt	37	19	
dec N.A. p. II.	17°	0′	22″S
diff. 43″ × 7·33	—	5	24
	16	55	
	90		
polar distance	106	55	

true alt.	37°	19′		
polar distance	106	55	co.sec.	0·01921
latitude	10	6	sec ..	0 00678
sum	154	20		
half sum	77	10	cos...	9·34658
remainder	39	51	sine..	9·80671
log. (T.33) hour angle	3h	3m	= ...	9·17928
app. time ship	20	57		
equa. time	—	16		
mean time ship	20	41		
mean time Greenwich	16	27		
longitude	4	14 =	63° 30′ East.	

1852, April 3, P.M. at ship, in latitude 35° 18′S. with observed altitude ☉ 31° 12′ eye at 16 feet, and time by chronometer 3d. 5h. 28m. 45s. fast 1h. 2m. 15s. for Port Praya, March 3, and losing 5s. daily; required the longitude.

time by chron.	5h	28m	45s
fast, March 3.	1	2	15
	4	26	30
rate 5s × 31d. 4½h. =	+	2	36
	4	29	6
long. P.Praya (p.325)	1	34	4
mean time Greenwich	6	3	10

☉'s dec. p.II. N.A.	5°	28′	57·4″N.
diff. 57·15″ × 6h 3m. =	+	5	45·7
red. dec.	5	34	43
	90		
polar distance	95	34	43
equa. time p.II. N.A.		3m	14·86s
diff. ·746 + 6h.3m.		—	4·51
red. equa. + to a. t.		3	10

obs. alt. ☉'s l.l.	31°	12′	6″		
dip, 16 feet 3′ 50″ corr...... 1 27	—	5	17		
	31	6	43		
semid. p II. N.A.	+	16	0		
	31	22	43		
polar distance ...	95	34	43	cosec .	0·002062
latitude.........	35	18	0	sec. ..	0·088237
sum.	162	15	26		
half sum........	81	7	43	cos. ..	9·188132
remainder.......	49	45		sine...	9·882657
log. app. time (T.33).......	2h	59m	0s	......	9·161088
equa. time	+	3	10		
mean time ship	3	2	10		
mean time Greenwich.......	6	3	10		
longitude.................	3	1	=	45° 15′ West.	

Examples for Exercise.

1. 1852, May 3, P.M. at ship, in latitude 9° 3′N. with observed altitude Arcturus, east of meridian 44° 6′, at 10 feet, time by chronometer 3d. 3h. 46m. 6s. fast 1h. 43m. 10s. at Esperitu Santo, March 9, gaining 3·2s. daily; required the longitude?

Answer.—55° 15′E.

2. 1852, June 16, P.M. at ship, in latitude 28° 12′N. with observed altitude Jupiter, west of meridian 27° 50′, index error —10″, at 18 feet, time by chronometer 16d. 15h. 58m. 51s. slow 17m. 41s. at Cronstadt, May 15, gaining daily 6s.; required the longitude?

Answer.—30° 38′W.

3. 1852, July 31, P.M. at ship, in latitude 30° 23′S. with observed altitude ☾ 45° 23′ 20″, at 19 feet, time by chronometer 31d 14h 39m 34s fast 1h. 2m. 20s. at Cape Town, July 6, and losing 4s. daily: required the longitude?

Answer.—39° 0′ 45″W.

When several chronometers are on board, the longitude may be deduced from them all by means of one set of altitudes, and the corresponding times in the following manner.

Immediately before making the observations, let one of the chronometers be compared with each of the others, carefully noting their differences; the mean of the time shewn by the above chronometer, when the altitudes are taken, is to be applied to these differences, which will give the corresponding times by each chronometer.

To these times apply the original and accumulated errors of the mean times at Greenwich or other meridian, to which the chronometers are set, the differences between which, and the mean time at ship deduced from the altitudes, will give the longitude according to each chronometer.

Instead of noting the times by one of the chronometers, a good pocket watch shewing seconds, may be employed for that purpose, but in this case it will be necessary to compare the watch with the chronometers immediately after the observations are made, as well as before commencing them; and should they not remain the same, a proportional part of the change of differences should be applied to those shewn before the altitudes were taken.

Example.—1852, July 24, A.M. at ship, in latitude 14° 40′N. with observed altitude ⊙ 57° 44′ 10″, at 20 feet, time by chronometer No. 1546 23d. 23h. 48m. 41s. slow 11m. 33s. for mean noon Greenwich, June 18, losing daily 1·3s. No. 1546 being compared with three other chronometers as in the annexed table, p. 212; required the longitude by each chronometer, brought on to noon, ship having made 6¾′ diff. long. to west, since time of observation?

time by chron. No.1546.	23d	23h	48m	41s	⊙'s dec. N.A. p.II. ...	19° 48′ 26″N.
slow .... 11m 33s }		+	12	20		90
rate 1·3s × 36d. = 47 }						
mean time Greenwich ...	24d		1	1	polar distance.	70 11 34
⊙'s l.l.		57°	44′	10″	eq. t. + to app time....	6m 11s
dip, 4′ 17″ cor. 31″......		—	4	48		
		57	39	22		
semid. N.A.		+	15	46		
true alt.		57	55	8		
polar distance ...		70	11	34	cosec..	0·026485
latitude.........		14	40		sec. ..	0·014387
sum............		142	46	42		
half sum........		71	23	21	cos....	9·503980
remainder.......		13	28	13	sine ..	9·367245
log. (T.33) hour angle.....		2	12	51	......	8·912097
app. time ship...........		21	47	9		
equa. time...............		+	6	11		
mean time ship.......	23d	21	53	20		
mean time Greenwich .	24d		1	1		
long. by No.1546......		2	7	41	=	31° 55′ 15″West.
run to noon, west.....................						+ 6 45
long at noon.........................						32 2 0 W.

	No. 853.			No. 1070.			No. 1650.		
	h	m	s	h	m	s	h	m	s
Chronometer, No. 1546	23	43	0	23	43	30	23	44	0
Chronometers	23	25	20	23	19	17	23	48	40
Differences..................	—	17	40	—	24	13	+	4	40
Chronometer, No 1546, at time of mean altitude	23	48	41	23	48	41	23	48	41
	23	31	1	23	24	28	23	53	21
Whole errors of chronometers ..		30	13		36	20		7	18
Mean time at Greenwich, by chronometer..............	0	1	14	0	0	48	0	0	39
Mean time at ship, by altitudes.	21	53	20	21	53	20	21	53	20
Long. in time, by chrons......	2	7	54	2	7	28	2	7	19
Long. of ship..	31°	58′	30″	31°	52′	0″	31°	49′	45″
Longitude made to noon.		6	45		6	45		6	45
Longitude at noon	32	5	15	31	58	45	31	56	30
Longitude by 1070	31	58	45						
,, 1650...........	31	56	30						
,, 1546...........	32	2	0						
Mean longitude at noon	32	0	37						

As it is the object of Lunar observations, to ascertain at the moment of observation, the mean time at Greenwich, the method used at sea by some of our most practical and experienced Masters in the Merchant Service, for that purpose, is both simple and well calculated for use, when there are chronometers on board. The error of the chronometer on Greenwich mean time is found at once, without any regard to the time or change of longitude between the observations, and having ascertained this error, the time at ship can be found at the most convenient opportunity afterwards; then by allowing the rate of the chronometer on the time between the observations, the difference between the Greenwich time as shewn by chronometer, (corrected for the above error) and the time at ship, is the longitude.

To find the true and apparent altitudes of the heavenly bodies.

It frequently happens at sea, in taking lunar observations, that the horizon is so badly defined, that an opportunity of finding the longitude may be lost, because the altitudes of the heavenly bodies cannot be obtained, in which case, it will be necessary to compute the altitudes, which may be done as follows.

The latitude and longitude of the place of observation, and the apparent time at the place given, to find the apparent altitude of the sun's centre.

Rule.—Reduce the given apparent time at ship, to the apparent time at Greenwich, to which reduce the sun's declination; when the latitude of the place and the sun's declination are of different names, take their sum, if of the same name, their difference, which will be the meridian zenith distance of the object.

Take the meridional zenith distance from 90°, and the remainder will be the meridian altitude.

To the log. versed sine of the apparent time from noon, add the log. co-sines of the latitude and the declination, their sum, rejecting 20 from the index, will be the log. of a natural number, to be taken from the natural sine of the meridional altitude, the remainder will be the natural sine of the true altitude.

To the sun's true altitude thus found, apply the corresponding correction, in Table 13, for the apparent altitude of the sun's centre.

The sun's horary distance is always to be expressed in *apparent time*, and in determining the sun's altitude for any given time before mid-day, it is the difference between the apparent time and 24 hours, that will express the horary distance from the meridian, as the time is reckoned astronomically from the preceding noon.

Example.—Required the true and apparent altitude of the sun's centre, June 4, 1852, at 8h. 20m. 12s. A.M. apparent time, in latitude 30° 20′S. longitude 150°E.

time at ship, June 3.......	20h	20m	12s
longitude in time, E.	10	0	0
ap. time Greenwich, June 3.	10	20	12
⊙'s dec. N.A. p.I......	22°	22′	26·9″
diff. 1h. 17·58″ × 10⅓ =	+	3	1·7
⊙'s red. dec.	22	25	28·6

latitude..............	30°	20′	0″S.
⊙'s red. dec..........	22	25	29 N.
⊙'s mer. zen. dist.	52	45	29
	90		
⊙'s mer. alt.	37	14	31

time from noon	3h	39m	48s
latitude	30°	20′	0′S
declination	22	25	29N
mer. alt.	37	14	31
true alt.................	15	23	57
cor. Table 13...........	+	3	16
app. alt.	15	27	13

log rising.			4·62911
cosine.			9·93606
cosine......................			9·96585
nat. sine.	60518		
nat. num	33964	=	4·63102
nat. sine	= 26554		

Example for Exercise.

Required the true and apparent altitudes of the sun's centre, March 20, 1852, at 4h. 6m. 24s. P.M. apparent time, in latitude 36° 18′N. and longitude 58° 5′ 10″W.?

Answer.—True altitude - - - - - 22° 38′ 28″
Apparent altitude sun's centre 22 40 36

To find the true and apparent altitude of the moon's centre, having the apparent time at the place of observation, the latitude and longitude given.

RULE.—Reduce the given apparent time at ship to mean time at the meridian of Greenwich page 160, to this reduce the sun's right ascension, likewise the moon's right ascension, declination, and horizontal parallax, as directed in page 164.

To the sun's reduced right ascension, let the mean time be added, and the sum will be the right ascension of the meridian, the difference between which and the moon's reduced right ascension, will be the horary angle of the moon.

With this horary distance from the meridian, her declination and the latitude, compute her true central altitude as follows.

To the log versed sine of the moon's horary angle, add the log. cosine of the latitude, and that of the corrected declination, their sum, rejecting 20 from the index, will be the log. of a natural number, to be taken from the natural sine of the meridian altitude, the remainder will be the natural sine of the true altitude.

With this true central altitude find the correction, Table 24, as directed in page 215, and the result will be her apparent central altitude.

Example.—August 20, 1852, at 5h. 30m. 16s. P.M. apparent time, in latitude 30° 20′N. longitude 40° 32′ 14″W.; required the true and apparent altitudes of the moon's centre?

app, time ship, Aug.20 p.m.	5h	30m	16s
long. in time, West......	2	42	8·93
app. time at Greenwich...	8	12	25
red. equation	+	3	0
mean time Greenwich....	8	15	25
☽'s hor. par.	59′	40·2″	
cor. for 8h 15m 25s........	—	7	5
	59	32	7
cor. for spheroidal figure of the earth, (T.43a).	—	3	0
red, hor. par.............	59	29	7

☉'s right ascen. mean noon	9h	58m	58·93s
diff. 1h.=9s·253 × 8·257	+	1	16·40
☉'s red. right ascen. ...	10	0	15·33
app. time at ship.......	5	30	16
right ascen. of mer. or, sid. time.	15	30	31·33

☾'s right ascen.	14°	32′	37·99″
aug. for 15m 25s.	+		34·93
☾'s red. right ascen. ...	14	33	12·92
sid-time or rt. asc. of mer.	15	30	31·34
hour angle	0	57	18·42

☾'s dec. N.A. at 8h...	10°	27′	29·30″	S
diff. 10′ = 128·13 × 1·54 =	+ 3		17·70	
☾'s red. dec..........	10	30	47	S.
latitude..............	30	20	0	N,
mer. zen. dist..........	40	50	47	
	90			
moon's mer. alt.	49	9	13	

hour angle.	0h 57m 18s
declination	10° 30′ 47″ S.
latitude..................	30 20 0 N,
☾'s mer. alt.............	49 9 13
☾'s true alt.	46° 53′ 33″

log rising, T.30		3·49276
cosine....................		9·99265
cosine....................		9·93606
nat. sine..	75646	
nat. num.	2639	log. 3·42147
nat. sine..	73007	

To reduce the moon's true to her apparent altitude.

Rule.—From Table 24, take out the correction to the next less tenth minute of altitude, and the minutes of H. P. and subtract it from the moon's true altitude, noting the remainder.

From the same Table take out the corrections answering to the said remainder in the usual manner, and apply them with contrary signs to the moon's true altitude, taken out again for that purpose, and the result will be the moon's apparent altitude.

Example.—Suppose the moon's true altitude to be 46° 53′ 33″, as above, and the H.P. 59′ 29″; required her apparent altitude?

Moon's true altitude	46°	53′	33″
Cor. answering to 46° 50′ and H.P. 59 ...	—	39	28
	46	14	5
Moon's true altitude....................	46	53	33
Cor. answering to 46° 10′ and H.P. 59 ...	—	39	57
	46	13	36
Cor. answering to 4′ of altitude..........	+		3
	46	13	39
Cor. answering to 29″ of Par.	—		19
Moon's apparent altitude................	46	13	20

TO FIND THE LONGITUDE,

BY LUNAR OBSERVATION.

This problem may be said to consist of four distinct operations, viz:

1. From the observed, to find the apparent altitudes and distance.

2. Having the apparent altitudes and distance to find the true distance.

3. Having the true distance, to find the corresponding mean time at Greenwich.

4. To find the mean time at ship, and thence the longitude.

1. *From the observed to find the apparent altitudes and distance.*

Rule.—To the estimated astronomical time at sea, apply the longitude by account in time, by *addition* or *subtraction*, according as it is west or east; the sum or difference will be the estimated time at Greenwich, which may however be more readily found by a chronometer, (should one be at hand) whose error for that meridian is known.

From page III. of the month in the Nautical Almanac, take out the moon's semidiameter and horizontal parallax,† reduce them to the estimated Greenwich time, if that time be considerably distant from noon or night, and to the semidiameter (thus reduced if necessary,) add the moon's augmentation (T. 22.)

Then, *if the sun be observed*—to the moon's augmented semidiameter add the sun's semidiameter, taken from page II of the month in the Nautical Almanac, and the observed distance, their sum will be the apparent distance; but *if a star or planet be observed,* the moon's augmented semidiameter is to be added to the observed distance if the nearest limb be taken, but subtracted from it if the furthest limb be observed; and their sum or difference will be the apparent distance.

2. *To find the apparent altitudes,*

For the Moon. From her observed altitude subtract the dip (T. 8.) and to the remainder add her augmented semidiameter if her lower limb be observed, but subtract her augmented semidiameter from it if the upper limb be taken.

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[*] In finding the Greenwich time for this purpose strict accuracy is not requisite, as a trifling error in the time will not materially affect the final result.

[†] The moon's H.P. is taken out together with the moon's semidiameter to save trouble and is reserved to be applied in finding the true distance.

For the Sun. From his observed altitude subtract the dip, and to the remainder apply his semidiameter by addition or subtraction, according as his lower or upper limb is taken, and the result will be his apparent altitude.

For a Star or Planet. From the observed altitude subtract the dip, the remainder will be its apparent altitude.

It will however be found, that 12′ added to the observed altitude of the sun or moon's lower limb, and 20′ subtracted from the moon's upper limb, will give the apparent altitude of their centres with sufficient accuracy for general practice.

In correcting the *distance* by the method given in this work, the *apparent altitudes* only are used, but in finding the time the *true altitudes* are always employed.

Having the apparent altitudes and distance to find the true distance.

From Table 34 take out the logarithm of the sun or star's apparent altitude, and also the logarithm of the moon's apparent altitude.

To the logarithm of the sun or star's apparent altitude, add the logarithmic sine (T. 5) of the apparent distance, (taken out to four places of decimals only) their sum, rejecting 10 in the index, will be the proportional logarithm (T. 35) of correction 1, which is always to be subtracted from the apparent distance.

To the logarithm of the moon's apparent altitude, add the logarithmic tangent, (T. 5) of the apparent distance, rejecting 10 in the index, their sum will be the logarithm of the 2nd correction, to be added to the former remainder, when the apparent distance is less than 90°, but to be subtracted from it, when the apparent distance exceeds 90°.

To this sum or difference add the correction answering to the apparent distance, and apparent altitudes, (T. 36) which will be the true distance between the moon and a star, but if the sun be one of the observed objects, a farther correction from Table 37, must be applied.

Having the true distance to find the corresponding mean time at Greenwich.

Among the lunar distances, pages xiii to xviii of the month, in the Nautical Almanac, seek for the true distance, either on the given day, or that immediately preceding or following it; then, if the true central distance be exactly found, the corresponding mean time at Greenwich will be found standing over it at the top of the column, but if the true distance cannot be exactly found, as will almost always be the case, find the two distances between which the true distance falls, and take out the intermediate proportional logarithm from the column headed "P.L.ofDiff." subtract this proportional logarithm from the proportional logarithm, (T. 35) of the difference between the true distance and that under the next less hour, the remainder will be the proportional logarithm of a portion of time, which, added to the above mentioned next less hour, will give the mean time at Greenwich corresponding to the true distance, correctly enough for general practice.

When extreme accuracy is required, and more particularly when the proportional logarithms between the distances in the Nautical Almanac increase or decrease by very considerable differences, a correction from Table 39, or page 588 of the Nautical Almanac for 1852, for the irregularity of the moon's motion, whereby the want of uniformity in the distances recorded in the Nautical Almanac is produced, must be applied to the above Greenwich time.*

To find the mean time at ship, and thence the longitude.

From the apparent find the true altitude of either of the objects employed in the lunar observation, and thence the mean time at ship, by rules already given for that purpose; find the difference between the mean time at Greenwich, and mean time at ship, this difference converted into degrees, minutes, &c. will be the true longitude of the ship, *east* if the time at ship exceed the time at Greenwich, but *west* if the Greenwich time be greater than the time at ship.

Example 1.—1852, March 12, A.M. at ship, in latitude 40° 17′S. 41° 15′E. mean time at ship 11d. 21h. 3m. with observed altitudes ☉ 33° 46′, ☾ 40° 21′, both at 13 feet, observed distance 97° 25′, index error to dist.—5″; required the longitude by observation?

m. t. s.	21h 3m	☾'s sem. midn...	15′ 52″	hor. par	58′ 14″
long. E........	— 2 45	cor. for 6h 18m...	— 4		— 13
m. t. G.........	18 18		154 8	red. hor. par.....	58 1
		aug. (T.22)	+ 10		
before noon, 12th.	5 42				
		☾'s cor. semid....	15 58		
obs. dist.	97° 24′ 55″	☉'s l. l.	33° 46′	☾'s l.l.	40° 21′
☉'s semid....	+ 16 6		+ 12		+ 12
☾'s „	+ 15 58				
		ap. alt	33 58	....	40 33
		log. (T.34)	7445	....	6787
ap. dist.	97 56 59	sine (T.5)	9·9958	tangent.........	10·8549
sum 1 & 2 cor.	— 38 0	—32′ 44″...... =	7403	—5′ 16″ ..... =	1·5336
	97 18 59				
3 cor. 2′11″—6″	+ 2 6				
true dist. ...	97 21 5				
true dist N.A.	97 30 30	at............	18h 0m 0s	pro log. N.A.... .	2821
diff.	9 25	pro. log..................		....	1·2814
			+ 18 2	pro log.	9993
cor. T. 39.		....	— 2		
mean time Greenwich by obs.		....	18 18		

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* See the explanation to Table 39.

☉'s ap. alt.	33°	58′			
cor. T.13	—	1			
true alt.	33	57			
polar distance	86	46		cosec.	0·00069
latitude	40	17		sec.	0·11756
sum	161	00			
half sum	80	30		cos.	9·21761
remainder	46	33		sine	9·86092
☉'s h ∠ E.(T.33)	3h	6m	57s	=	9·19678
	20	53	3		
red. equa. time	+	9	55		
mean time ship	21	2	58		
mean time Gr.	18	18			
long	2	44	58	=	41° 14′ 30″ East.

dec. p.ii. N A.	3°	8′	13″S.
diff. 58·95″ × 5h 42m.	+	5	36
	3	13	49
	90		
polar dist.	86	46	
equa. time		9m	50·79s
diff. 683 × 5h. 42m.		+	3·89
		9	55

Ex. 2.—1852, March 9d. 13h. 11m. mean time at ship, in latitude 3° 20′N. longitude 84° 45′W. with observed altitudes of Regulus west of meridian 53° 32′, ☾ 46° 31′, both at 18 feet, observed distance ☾'s near limb 79° 24′ 15″, index error for distance —10″; required the longitude?

m. t. ship	13h	11m
long.	+ 5	39
mn. time Gr.	18	50

☾'s semid. N.A.	16′	19·2″
cor. for 6h. 50m.	—	3·6
	16	15·6
aug. (T. 22)	+	11·4
	16	27

hor. par	59′	53·4″
	—	13·3
	59	40

obs. dist.	79°	24′	15″
index	—		10
	79	24	5
☾'s semd.	+	16	27
app. dist.	79	40	32
diff. 1 & 2 cor.	—	40	51
	78	59	41
3rd cor.	+	1	35
true dist	79	1	16
true dist. N.A.	78	31	16
diff.		30	0

diff. p. logs. N.A. increasing 15

✱ alt.	53°	32′
dip	—	4
app. alt.	53	28
log. (T.34)		0·5743
sine		9·9929
— 48′ 46″ = p. log.		5672
+ 7 55		

☾'s l. l.	46°	31′
	+	12
	46	43
		0·6172
tang.		10·7395
+ 7′55″ p. log.		1·3567

at	18h	0m	0s
pro. log			
	+	50	2
cor. (T.39)	—		4
mean time Greenwich, by obs	18	49	58

pro. log.	2222
	7782
	5560

✱ app. alt.	53°	28			
cor. (T.7)	—	1			
true alt.	53	27			
polar dist.	77	19		cosec.	0·01073
latitude	3	20		sec.	0·00073
sum	134	6			
half	67	3		cos.	9·59098
remainder	13	36		sine	9·37133
log. (T.33) ✱ h. ∠					8·97377
m.t.G. by obs.	18h	49m	58s		
m. t. ship	13	11	2		
long. W.	5	38	56	=	84° 44′

s. t. N.A.	23h	9m	18s
acc. for m. t. G.		3	6
s. t. red.	23	12	24
✱ dec. N.A.	12°	41′N	
	90		
polar dist.	77	19	
✱ r. a. N.A.	10h	0m	30s
✱ hour ∠	2	22	56
s. t. s. + 24h	12	23	26
s. t. red.	23	12	24
mean time ship	13	11	2

When the observation for the altitudes and distance cannot be taken at the same time, for want of proper assistants on board, the following method may be adopted, by which one observer can, with a good quadrant to take the altitudes, and a sextant for the distance, make the different observations himself, with sufficient accuracy.

First, take an altitude of the sun, star, or planet; secondly, the altitude of the moon; thirdly, any number of distances; fourthly, again the altitude of the moon; fifthly, the altitude of the sun, star, or planet; and then proceed as explained in page 197 or by proportional logarithms, as follows.

Ex. 3.—1852, March 28, P.M. at ship, in latitude 36° 17′N. with the following times by chronometer, fast 7m. 16s. for mean time Greenwich, observed altitudes ☉ and ☾, at 13 feet, and their observed distances with an index error +20″; required the mean time at Greenwich, and its comparison with mean time at Greenwich by chronometer.

	Times by chron.		Dist. ☉——☾		☉'s l.l.	☾'s u.l.
1..........	5 58 28		° ′ ″		37°33′30″	° ′ ″
2..........	59 18	....			....	48 16 20
3..........	6 0 24		88 32 10			
4..........	1 10		32 30			
5..........	2 14		33 20			
6..........	3 20	....			....	49 4 50
7..........	4 13	....			36 33 0	
sum of 3,4.5 ÷	3)18 3 48	3)	98 0	dif.1	0 30	48 30
the mean	6 1 16		88 32 40			
error	— 7 16		+ 20	☾'s h p. at noon.		56 27·5
m. t. G. by chro.	5 54		88 33	increase for 6h...		12·5
☾'s semid. at noon.	15′23″	☉'s semid. ..	16 2			56 40
increase for 6h....	+ 3·4	☾'s „	15 38			
augmentation.....	11·6	ap. dist.....	89 4 40			
mean of times..	6 1 16	....			6 1 16	
time 1........	5 58 28	time 2		....	5 59 18	
	2 48	pro· log.........	1·8081	....	1 58	1·9615
diff. of 1 & 7..	5 45	ar. co. pro. log...	8·5044	dif.2 & 6.	4 2	8·3504
„ ☉'s alts...	1° 0′ 30″	pro. log.........	·4735	„ ☾'s alt.	48 30	·5695
cor. ☉'s 1st alt.	29 30	pro. log.........	·7860	cor 1st. alt..	23 40	·8814
„ „	37 33 30			☾ 1st alt.	48 16 20	
mean alt.....	37 4			mean alt-	48 40	
cor..........	+ 12			cor.....	— 20	
☉'s ap. alt. ..	37 16	log.............	·7199	☾ ap alt.	48 20	log. 6287
ap. dist......	89 4 40	sine............	9·9999	....		tan.11·7932
1st cor.—34′19″	—33 38	p. log.	·7198			
2 cor. — 41		....		.... p. log.		2·4219
	88 31 2					
3 cor. + 1 54	+ 1 52					
rd. par. — 52						
true dist.....	88 32 54					
dist. N.A....	87 6 57	at..........	3h 0m 0s	p. log. N. A.-.....		3065
diff.........	1 25 57	pro. log.		....		3210
approx. interval		....	2 54 6	pro. log.		0145
diff. p. logs. N.A. 17 dec.			5 54 6			
cor. (T.39)		....	+ 1			
m. t G. by lunar..			5 54 7			
„ by chron.		....	5 54			
c . fast of obs.........		....	7			

If the sun or star be too near the meridian, or if the altitudes have not been observed correctly enough for finding the time with exactness, although with sufficient accuracy for clearing the distance, the error of the watch or chronometer, by which the time of the observation was noted, must be found by altitudes taken when the sun or star is more favorably situated with respect to the meridian, and applied to the time shewn by the watch or chronometer when the distance was taken, by addition or subtraction according as it is slow or fast, the sum or difference will be the time at the meridian where the error of the watch was found, at the instant when the distance was measured, the difference between which time and the time at Greenwich, found as above, from the distance, will be the longitude of the place where the altitudes were taken for finding the error of the watch.

Examples for Exercise.

1.—1852, March 15, A.M. at ship, in latitude 9° 46'S. at 15d 4h 22m 30s. by chronometer, slow 33m. 10s. for mean time Greenwich, with observed altitudes ☉ 69° 48′ 45″, eye at 16 feet, ☾ 53° 30′ 40″, eye at 12 feet, observed distance 56° 16′ 30″, index error for distance —13″; required mean time Greenwich, and its comparison with the mean time Greenwich by chronometer.

Answer.—Mean time Greenwich by observation 4h. 55m. 59s.
chronometer slow 19s.

2.—1852, March 2, P.M. at ship, in latitude 10° 45′N. at 2d 7h 43m 46s. by chronometer, fast 13m. 46s. for mean time Greenwich, with observed altitudes of Venus 33° 18′ 30″, eye at 22 feet, ☾ 46° 12′ 10″, eye at 21 feet, observed distance ☾'s near limb 97° 35′ 10″, index error to distance +7″; required mean time Greenwich, and its comparison with mean time Greenwich by chronometer.

Answer.—Mean time Greenwich by observation 7h. 29m. 59s.
chronometer fast 1s.

3.—1852, March 29, P.M. at ship, in latitude 14° 15′N. at 29d. 2h. 11m. 32s. by chronometer, slow 9m. 38s. for mean time Greenwich, with observed altitudes Spica, 40° 38′ 50″, eye at 16 feet, ☾ 40° 45′, eye at 19 feet, observed distance ☾'s far limb 94° 50′ 15″, index error to distance —4″; required mean time Greenwich, and its comparison with mean time Greenwich by chronometer?

Answer.—Mean time Greenwich by observation 2h. 20m. 59s.
chronometer fast 11s.

Additional Questions for Exercise.

Date.	Mean time at Ship.	Latitude.	Height of the Eye.	✱ Obs. alt.	☾ Obs. alt.	Obs. Distance.	Denomination of Star.	Longitude.
	h m s	° ′	ft.	° ′	° ′	° ′ ″		° ′
1852 Apr. 10	20 45 0	34 26S.	31	26 44	☾ 55 55	88 52 1	⊙	33 45W.
May 27	5 59 0	55 20N.	27	17 3	☾ 40 33	103 41 28	,,	14 45E.
Dec. 5	20 24 11	20 9N.	31	23 41	☾ 67 39	64 48 16	,,	23 57W.
Aug. 1	12 56 0	0	19	9 26E.	☾ 69 38	70 4 8	Satu rn	106 4W.
Oct. 3	8 30 49	5 15S	20	16 38W	☾ 62 28	46 43 34	Antares.	146 48E.
Dec. 31	17 10 18·	13 30N.	17	58 34E	☾ 83 6	29 34 38	Spica.	99 45W.

THE CALCULATION OF SECOND DIFFERENCES.

In computing the declination of the heavenly bodies, whose daily difference of declination is considerable, if extreme accuracy be required the proportional part of the daily variation of declination, for any given interval of time, must be corrected by *the equation of second, third,* and *sometimes fourth differences.* For ordinary purposes, the *equation of second differences* will be sufficient.

The same remark applies to the latitudes, longitudes, and right ascensions of the heavenly bodies, and to all calculations by interpolation of quantities, which are increased or decreased, not by uniformly equal quantities, but by quantities which are themselves also increasing or diminishing.

If the total interval be 12 hours for instance, and the variation or change for one hour be required, then it will be $\frac{1}{12}$ of the variation, for 12 hours, and the correction will be $\frac{1}{12}$ of $\frac{11}{24}$ of the mean second difference, that is $\frac{1}{12} \times \frac{1}{2}$ of the remaining $\frac{11}{12}$ and then multiplied by the mean second difference

For two hours $= \frac{1}{6}$ the correction will be $\frac{1}{6} \times \frac{5}{12} \times$ second difference.

For three hours $= \frac{1}{4}$ it will be $\frac{1}{4} \times \frac{1}{2}$ of $\frac{3}{4} \times$ second difference, or $\frac{3}{32}$ of second difference.

For four hours $= \frac{1}{3}$ the correction will be $\frac{1}{3} \times \frac{1}{3} = \frac{1}{9}$ of second difference.

And for five hours $= \frac{5}{12}$ it will be $\frac{5}{12} \times \frac{7}{24} \times$ second difference.

Lastly for six hours $=\frac{1}{2}$ the correction will be $\frac{1}{2}\times\frac{1}{4}=\frac{1}{8}$ of second difference. If the second difference be $12'=720''$, the correction will be

$$
\begin{array}{llll}
\text{for 1 hour} & 720''\times\frac{1}{12}\times\frac{11}{24} & = & 27{\cdot}5'' \\
\text{,, 2 ,,} & 720\times\frac{1}{6}\times\frac{5}{12} & = & 50{\cdot}0 \\
\text{,, 3 ,,} & 720\times\frac{1}{4}\times\frac{3}{8} & = & 67{\cdot}5 \\
\text{,, 4 ,,} & 720\times\frac{1}{9} & = & 80{\cdot}0 \\
\text{,, 5 ,,} & 720\times\frac{5}{12}\times\frac{7}{24} & = & 87{\cdot}5 \\
\text{,, 6 ,,} & 720\times\frac{1}{8} & = & 90.
\end{array}
$$

For 7 hours the correction will be the same as for 5 hours, for 8 hours the same as for 4 hours, &c.

When the *first differences* decrease, the correction will be additive, but whilst the first differences increase the correction will be subtractive.

When the first differences neither increase nor decrease, but remain equal for some time, then no correction will be necessary, for the proportional part for the given interval will be quite correct.

But when the first differences decrease and then increase, or first increase and then decrease, *half the difference* of *the two second differences* will be the *mean second difference*, and the correction will be but small, and additive or subtractive according as the second difference of the decreasing *first differences*, nearest the change, is greater or less than the second difference of the first two increasing *first differences* after the change. In all other cases half the sum of the two second differences will be the *mean second difference*.

Example.—Let it be required to find the ☉'s true declination at mean mid-night, on the 4th May, 1852?

					1st. diff.
☉'s decl. 3rd May, mean noon	15°	48′	9·0″		
					— 17 23·5
4th ,, ...	16	5	32·5		
					— 17 7·5
5th ,, ...	16	22	40·0		
					— 16 51·3
6th ,, ...	16	39	31·3		

The two second differences will be 16·0″, and 16·2″, and the mean second difference 16·1″, then $16{\cdot}1\times\frac{1}{8}=2{\cdot}0''$ the correction required, additive, because the first differences are decreasing.

Difference of 4th and 5th $=17'\ 7{\cdot}5''$, the half of which is $8'\ 33{\cdot}75''$, to which adding the correction $2''$, we have $8'\ 35{\cdot}75''$ for the variation of the declination for the first 12 hours; hence

$16°\ 5'\ 32{\cdot}5''+8'\ 35{\cdot}75''=16°\ 14'\ 8{\cdot}25''=$ the declination at mid-night.

2.—Supposed the ⊙'s declination for the 5th of May, 1852, to have been effaced, or obliterated, or printed so as not to be legible, it is required to find by interpolation, the declination for that day?

		1st. diff.	2nd diff
May 2 ⊙'s decl.	15° 30′ 29·8″N.		
		— 35 2·7	
4 „	16 5 32·5		—63.9″
		— 33 58·8	
6 „	16 39 31·3		—66·2
		— 32 52·6	
8 „	17 12 23·9		
		mean 2nd diff.	65·05
		cor. = ⅛ =	8·13

diff. of 4th and 6th...............		33′	58·8″
for one day	16		59·4
cor...................	+		8 1
cor. var. for 1 day...............		17	7·5
⊙'s decl. 4th	16	5	32·5
⊙'s decl. 5th....................	16	22	40·0 N. the same as given in the Nautical Almanac.

This proves the accuracy of the correction, for the declinations in the Nautical Almanac have been computed independently for every day, from the sun's longitude and the obliquity of the ecliptic.

3.—Suppose it were required to compute the moon's horizontal parallax for mid-night, of the 4th May, 1852; having given the horizontal parallax at noon for every day?

		1st.	2nd.
3rd May, Moon's hor. par..........	61′ 2·8		
		— 20·6″	
4th „ „	60 42·2		— 16·2
		— 36·8	
5th „ „	60 5·4		— 11·9
		— 48·7	
6th „ „	59 16·7		
			28·1
		mean second diff.....	14·05
		cor. = ⅛ =	—1·76
		diff. 4th and 5th = 36·8″; ½ of which =	18·40
		par. decreasing	16·6
		4th noon........... 60	42·2
		Moon's hor. par. 4th, midnight.... 60	25·6

See Nautical Almanac, 1852.

4.—Required the apparent declination of the planet Mercury ☿, on the 4th of March 1852, at the time of its transit over the meridian of Greenwich, astronomical time?

Mean time of transit over the meridian of Greenwich, on the 4th of March 1852, is 23h. 42m. astronomical time, (Nautical Almanac, page 256)

				1st diff.	2nd dif.
Decl. ☿ 3 March	12°	29′	46·1″S.		
				—39′ 15·9″	
4 „	11	50	30·2		— 78·5″
				—40 34·4	
5 „	11	9	55·8		— 78·2
				—41 52·6	
6 „	10	28	3·2		
				mean 2nd diff.	78·35

h. m

23 42 = 23·7

24) 0·9875

0·0125

0·00625

diff. of 4th and 5th		40′	34 4″
18m. = 1-80th of 24h......		0	30·43
cor. below		+	0·48
		0	30·9
declin. 4th............	11	9	55·8 S.
declin. of ☿	11	10	26·7 S.

At time of transit, see N.A. 1852, p. 257

to compute the above correction, we have ·9875 × ·00625 × 78·35 = 0·4837

By Logarithms.

0·9875	log.	=	9·99454
0·00625	log.	=	7·79598
2nd diff. 78·35″	log.	=	1·89404
			9·68456 = 0·4837

In this example, the correction 0·48″ is added, because it was due to a small interval at the close of the day, and required therefore a greater variation in the declination, than any preceding equal interval on the same day.

LONGITUDE FROM THE RISING AND SETTING OF THE SUN.

Among the various methods in use for determining the longitude at sea, a very simple and practical method, although not in very general use, because not very generally known or understood, is that which is deduced from the facilities afforded by the rising and setting sun.

The principle is adapted to the rising or setting of the moon, stars, and planets, also; but its application to these latter cases is more difficult, and therefore less likely to be generally adopted in practice.

To observe the time of the sun's rising or setting,

Set the sextant or quadrant to 16′ plus the dip, say 20′ on the limb, observe by means of a well regulated chronometer, the *Greenwich* *mean time*, when the sun's lower limb is at this elevation above the true horizon; then compute the *true time* at ship of the rising or setting, for which purpose it will be necessary to have previously determined the latitude as correctly as possible; the difference between the *apparent time* at ship, and the *Greenwich* apparent time, to which the *Greenwich mean time* must be reduced, will be the *difference of longitude in time.*

When the sun's lower limb is about 16′ above the horizon, the sun's *visible semidiameter* is only about 14′, being contracted about 2′ by refraction; consequently the sun's centre will then appear about 30′ above the horizon, whereby the sun's *apparent* altitude will be about 30′, which is also *very nearly* the amount of the refraction at this apparent altitude; so that when the sun's lower limb appears 16′ above the horizon, the sun's centre is supposed to be at the true horizon, and consequently, to indicate the true time of his rising or setting.

When the sun's rising or setting is observed in this manner, no allowance is to be made for the effect of refraction, in determining the time of his rising or setting by computation; because that effect is allowed for in attempting to observe the time of his *true* setting before his *visible* setting, or of his *true* rising after he has *visibly* risen.

But simple and feasible as this method may appear, it is much better and more certain to observe the time by chronometer, when the lower limb appears to touch the horizon, and again the instant when the upper limb disappears below the horizon; the middle time between these will be *very nearly* the Greenwich mean time, when the sun's centre appears at the horizon.

Compute then the apparent time of rising or setting, including the effect of refraction and dip, which retards the apparent time of setting, and accelerates that of rising; the difference between the apparent time thus *computed*, and the *observed* Greenwich *mean* time, reduced as before to Greenwich *apparent* time, will be the difference of longitude in time, which being converted into degrees, minutes and seconds, will be the longitude required.

To compute the semidiurnal arc, or time of sun rising or setting.

Rule.—To the log. tangent of the latitude add the log. tangent of the sun's declination, the sum will be the log. sine of the ascensional difference, which converted into time, and added to 6 hours, will give the time of setting, when the latitude and declination are both North, or both South; but the time of rising, when one is North and the other South.

To compute the effect of refraction in retarding the setting, and accelerate the rising of the sun.

Add together the latitude and declination; take also their difference, placing it under the sum, then add together the log. secant of the sum, and the log. secant of the difference, and to half the sum of the two log. secants, add the constant log. 2·139879, when refraction only is to be taken into account, this last sum will be the log. of the number of seconds of time, to be added to the semidiurnal arc, found by the preceding rule, as the effect of the horizontal refraction, at a mean temperature, or 30 in. of barometer, and 50° of Fahrenheit's thermometer.

The constant log. 2·139879 is the log. of 138, the number of seconds of time equal to the mean horizontal refraction, now believed to be, according to the best authorities, 34′ 32″. But to insure correct results, from this method of determining the longitude, the temperature of the atmosphere, indicated by the barometer and thermometer, should be carefully noted, and the corresponding horizontal refraction deduced from the usual tables for correcting the mean refraction.

Should the horizontal refraction be found, for instance to be 40′ = 160 seconds of time, then the log. of 160 should be substituted for the constant log. given above; and should the hor. refr. be only 30′ then the log. of 120 should be used, and so of any other amount of the horizontal refraction, caused by the constantly varying temperature.

When the dip of the horizon combines with refraction to retard the setting of the sun, or accelerate his rising, its amount must be added to that of the horizontal refraction, and the log. of the number of seconds of time equal to their sum, must be used instead of the constant log. 2·139879, which includes only the refraction. When an artificial horizon is used, no allowance is made for dip.

Example.—1852, May 20, A.M. civil time at ship, in lat. 61°30′N. and longitude by account 64° 10′ W. on board a ship on the Arctic expedition, or North Western Passage, the sun's lower limb, corrected for depression of the horizon, was observed at rising to be 16′ above the horizon, when the chronometer set to Greenwich mean time on the 1st of the same month, at noon, and which was observed to have gained 5·6ˢ daily, was at $19^h\ 25^m\ 30{\cdot}3^s$; required the true *mean time* at ship, and her true longitude at the time of observation?

	h m s
approx. Gr. mean time of obs.	19 25 30·3
cor. for daily rate, (gaining).	— 1 45·3
Gr. mean time of obs.......	19 23 45·0
equation of time...........	+ 3 44·4
Gr. app. time of observation.	19 27 29·4

☉'s dec. mean noon, 19th.	19°51′48·3″N
increase of dec. for 19h 23m 45s.........	10 9·0
☉'s dec. at rising........	20 1 57·3N.

latitude by account	61° 30′ 0″	N.	tang.	10·265236
declin..................	20 1 57	N.	tang.	9·561831
ascensional diff..........	42 11 8		sine..	9·827067
ditto in time............	2ʰ 48ᵐ 44·5			
add............	6 0 0		h m s	
app. time before noon	8 48 44·5	=	15 11 15·5	(on 19th) at ship
Greenwich app. time of observation...			19 27 29·4	19th day
diff. of long. in time...............			4 16 13·9	W.
longitude of ship			64° 3′ 28·5″	W.

	h	m	s
Apparent time at ship, 19th day.	15	11	15·5
equation of time	—	3	44·4
mean time at ship....................	15	7	31·1
Greenwich mean time of observation.....	19	23	45·0
diff. of long. in time, as before	4	16	13·9 W.
Longitude at ship	64°	3′	28·5 W.

Here the results are the same, whether we take the difference of the *mean* or the *apparent* times; but strictly, the difference of the *apparent* times should be taken, because the polar angles measure *apparent* time on the equator, not *mean* time; every 15 degrees on the equator indicating *one hour of apparent time.* At the end of December the daily difference of the apparent and mean times is 30ˢ, and consequently the diff. in 12 hours of time, or 180° of long. would be 15 seconds of time, or 3′45″ of longitude.

2—August 20, 1852, in east longitude and latitude, corrected by double altitudes, 58° 2′ 45″S, at 22^h 30^m 35^s *mean time at Greenwich,* on the 19th. by a chronometer regulated on the same day to Greenwich mean time, the sun's centre was observed setting, the above time being the mean of two observations of the lower and upper limbs at setting; Required the ship's longitude at the time of observation, the height of the eye being 18 feet?

⊙'s declin. corrected for the time of observation...... 12° 21′ 14″N.
Latitude .... 58 2 45 S.

refraction	+	34′	32″
dip............	+	4	4
par.............	—		9
cor, to zen. dist..	+	38	27

= 153·8 s. log. = 2·186956

latitude	58°	2′	45″S.	tangent	10·204984	
declin...........	12	21	14 N.	tangent	9·340485	
0·474364 sec	70	23	59	cos. ...	9·545469	
0·155824 sec.	45	41	31			

2) 0·630188 — 69° 26′ 37″
0·315094 — 4h 37m 46·5s.
2·186956 (above)
2·502050 = 318·05 s. .... + 5 18·0

Greenwich mean time =	22h 30m 35s		4	43	4·5
equation of time	— 3 6·6		+ 24	0	0·0
	22 27 28·4	Aug. 19th.....	28	43	4·5
	Greenwich apparent time	„ 19th	22	27	28·4
	diff. of long. in time		6	15	36·1
	long. in space		93°	54′	1·5′ E.

ON FINDING

THE VARIATION OF THE COMPASS,

BY ASTRONOMICAL OBSERVATION.

THE variation of the compass has already been described, (see p. 41,) as the deviation of the points of the mariner's compass from the corresponding points of the horizon, and it is denominated *east* or *west variation*, according as the north point of the compass is eastward or westward of the true north point of the horizon.

Now, this variation of the compass may be determined by various celestial observations, such as *amplitudes, azimuths, transits, equal altitudes*, &c. &c. and of these, amplitudes and azimuths of the sun are, perhaps, best adapted to nautical practice, and are consequently the methods principally used at sea for this purpose.

The *true amplitude* of any celestial object, is the arc of the horizon intercepted between the *true* east or west point of the horizon, and the centre of that object, at the time of its rising or setting.

The *magnetic amplitude* of an object is the arc of the horizon, intercepted between its centre, and the east or west *point of the compass*, at the time of its rising or setting, or, it is the compass bearing of the object, when in the horizon of the eastern or western hemisphere.

The *true azimuth* of a celestial object is the angle formed by the *true meridian*, and a vertical circle passing through the centre of that object.

The *magnetic azimuth* is the angle contained between the *magnetic meridian*, and the azimuth or vertical circle, passing through the centre of the object, or, it is the compass bearing of the object, at any given altitude above the horizon; hence, when the magnetic azimuth is observed, the altitude of the object must be taken, to obtain the true azimuth.

The true amplitude of a celestial object, and its true azimuth are found by calculation, and the magnetic amplitude and azimuth by an azimuth compass, as follows—

To observe by the azimuth compass the sun's amplitude.

In finding the variation by the sun's amplitude, the observation should [illegible] by compass, when the altitude of his lower limb is equal to the sum of his semidiameter, and the dip of the horizon, and this may be most readily effected by setting the index of the instrument, to the altitude thus determined, and then taking the sun's magnetic amplitude when his lower limb attains that elevation, at which instant, although the sun is apparently so elevated, by the atmospherical refraction, his centre is in fact in the horizon of the place of observation.

At the time of sun-rising or sun-setting turn the compass-box until the vane containing the magnifying glass, be directed towards the sun, so that when his limb is at a proper elevation, the bright speck, formed by the concentrated rays of the sun, may fall upon the slit in the other vane, then stop the card by means of the nonius, and read off the amplitude.

The amplitude may also be observed without using the magnifying glass, by directing the sight through the dark glass towards the sun, and when the sun is bisected by the thread in the other vane, stop the card and read off as before.

To observe by the compass the sun's azimuth.

Turn the box as before directed, and raise the magnifying glass until the bright speck falls on the other vane, or on the line in the horizontal [illegible] the card is then to be stopped, and the divisions being read off, will [illegible] the sun's magnetic azimuth, should the vibration of the card at the [illegible] observation be considerable, the mean of the vibrations may be [illegible] as the magnetic azimuth.

The altitude of the sun (as noticed above,) must be taken when the [illegible] azimuth is observed, in order to obtain the true azimuth.

To find the variation of the compass by the sun's amplitude.

Reduce the apparent time of the sun's rising or setting to [illegible] time at Greenwich, and to that time reduce also the [illegible] for the given day, taken from page I of the month, [illegible] Almanac; then, to the logarithmic secant of the latitude [illegible] sine of the sun's reduced declination, and their [illegible] the index, will be the logarithmic sine of the true [illegible] reckoned from the east in the morning, or from [illegible] towards the north or south according to the [illegible]

[illegible] thus found, and the magnetic amplitude [illegible] north or both south, their *difference*, [illegible] south their *sum* is the variation, and [illegible] westerly, let the observer be supposed [illegible] of the compass representing the *true* [illegible] amplitude be to the *left hand* of this [illegible] to the *right hand* it is *westerly*.

The sun's true amplitude may be taken out by inspection, from Table 41, (see the explanation to that Table) the result will however, of course, be in general less accurate than by the former method.

Ex. 1.—1852, July 14, P.M. at ship, in latitude 28° 53′S. mean time Greenwich 14d. 6h. 26m. with the ⊙'s magnetic amplitude W. 36°N.; required the variation of the compass?

Mean time Greenwich. 6h 26m.

⊙'s dec. p. ii. N.A.	21°	38′	33″N.
diff. 23·53″ × 6h 26m. .:.	—	2	31
reduced dec	21	36	

latitude	28°	53′	secant	·05769
dec. . . .	21	36	sine. .	9 56599

true amplitude. . . . sine. . 9·62368 =	W.	24°	52′N
magnetic amplitude	W.	36	0 N
Variation West, the mag. amp. to right hand of true amplitude.		11	8

By Inspection, T. 41.

With latitude 29° and dec. 21° 30′ the true amp. is	24°	46′
allow an increase for 6′ of dec. .... =		6
⊙'s true amplitude..................................	24	52

Ex. 2.—1852, November 20, A.M. at ship, in latitude 11° 3′S. mean time Greenwich 19d. 23h. 44m. with the ⊙'s magnetic amplitude E.13°S. required the variation of the compass?

Mean time Greenwich -	23°	44′
before noon - - - - -		16

⊙'s dec. p. ii. N.A. on 20th	19°	48′	54″S.
diff. 34·10″ for 16m - - - -	—		9
	19	48	45

latitude - - - -	11.	3′	sec. -	0·00813
dec. - - - - -	19	49	sine	9·53021

true amplitude - - - - - - - sine 9·53834 =	E.	20°	12′S.
magnetic amplitude - - - - - - - - - - - - - -	E.	13	0 S.
Variation, East, the mag. to left hand of true amp.		7	12

Examples for Exercise.

1.—1852, April 15, A.M. at ship, in latitude 47° 10′N. mean time Greenwich 14d. 19h. 46m. with the ⊙'s magnetic amplitude E.16°S. required the variation of the compass?

Answer.—Variation 30° 36′W.

2.—1852, October 13, P.M. at ship, in latitude 39° 50′N. mean time Greenwich 13d. 15h. 18m. with the ⊙'s magnetic amplitude W.27°S.: required the variation of the compass?

Answer.—Variation 16° 19′E.

To find the variation of the compass by the sun's azimuth.

Rule.—Reduce the mean time of observation, and also the sun's declination at noon of the given day, to the corresponding time at the meridian of Greenwich: find likewise the sun's polar distance, and from his observed, compute his true altitude.

To the sun's true altitude add his polar distance, and the latitude of the ship or place of observation; take half their sum, and find the difference between the half sum and the polar distance, calling this difference the *remainder*, then,

To the secants, less radius, of the true altitude and the given latitude, add the co-sines of the half sum and the remainder, half the sum of these four logarithms, will be the sine of half the sun's true azimuth, to be reckoned from the *south* in *north* latitude, and from the *north* in *south* latitude, towards the *east* in the *forenoon*, and towards the *west* in the *afternoon*.

Then, if the true and observed azimuths be both reckoned from the same point, their difference is the variation; but if one be computed from the north and the other from the south, take the true azimuth from 180°, and the difference between the remainder and the magnetic azimuth will be the variation; and to know if it be east or west, suppose the observer to be looking towards that point of the compass which represents the *true azimuth*, when if the magnetic azimuth be to the *left* hand of the observer, the variation is easterly, but if to his right it is westerly.

Ex. 1.—1852, June 12, A.M. at ship, in latitude 25° 21′N. mean time Greenwich 11d. 9h. 25m. the observed altitude $\underline{\odot}$ 37° 5′, eye at 14 feet, ⊙'s magnetic azimuth S. 109° E.; required the variation of the compass?

m. t. G. 11d 9h 25m.			⊙'s dec. p. ii N.A.	23°	7′	36″	N.	diff. 9·59″
			cor. for m. t. G.	+	1	30		× 9·25
				23	9			
				90				90·
			polar distance	66	51			
obs. alt. ⊙'s l.l.	37°	5′						
cor. T. 14.......	+	11						
true alt.........	37	16	sec.........	0·09918				
latitude.........	25	21	sec.........	0·04397				
polar distance ...	66	51						
sum.	129	28						
half sum........	64	44	cos.	9·63025				
remainder.......	2	7	cos.	9·99970				
			2)	19·77310				
	50	22	sine	9·88655				
		× 2						
⊙'s true azim. S.	100	44E.						
,, mag. azim. S.	109	E.						
var............	8	16	The mag. azim. being to the left of the true,					

Ex. 2,—1852, May 6, P.M. at ship, in latitude 44° 11′S. mean time Greenwich 5d. 23h. 16m. the observed altitude $\underline{\odot}$ 17° 13′ eye at 16 feet, ☉'s magnetic azimuth N.12°W.; required the variation?

m. t. G.	5d 23h 16m	☉'s dec. p. ii. N.A.	16° 39′ 31″N.	diff. 1h.	42·14″
		cor. for 44m. ...	— 31		× 44
a.m. 6th.	44				
			16 39		31
			90		
		polar distance ...	106 39		
obs. alt. ☉'s l.l. ..	17° 13′				
cor. T.14.	+ 9				
☉'s true alt.	17 22	sec.	0·02026		
latitude.	44 11	sec.	0·14441		
polar distance. ...	106 39				
sum	168 12				
half sum.	84 6	cos.	9·01196		
remainder.	22 33	cos.	9·96545		
			2)19·14208		
	21 52	sine.	9·57104		
	× 2				
☉'s true azim. N.	43 44W				
☉'s mag. azim. N.	12 0W				
var.	31 44W	mag. azim. to the right of the true.			

Examples for Exercise.

1.—1852, July 22, P.M. at ship, in latitude 18° 5′S. mean time Greenwich 22d. 8h. 36m. the observed altitude $\underline{\odot}$ 28° 59′, at 12 feet, ☉'s magnetic azimuth N. 65°W.; required the variation?

Answer.—11° 40′E.

2.—1852, August 28, A.M. at ship, in latitude 13° 20′N. mean time Greenwich 27d. 17h. 16m. the observed altitude $\underline{\odot}$ 39° 48′, index error +12″, at 16 feet, ☉'s magnetic azimuth S.83°E.: required the variation?

Answer,—8° 32′W.

ON TIDES.

The word tide is used to denote that motion of the water in the seas and rivers, by which they alternately rise and fall twice in the course of about twenty four hours and three quarters; the rising of the waters being denominated the *flux* or *flood*, and the falling the *reflux* or *ebb*.

These phenomena are the effect of the attraction of the sun and moon upon the widely extended waters of the ocean, but are principally under the influence of the moon, as is obvious from their always being found (local circumstances and other causes of partial derangement being allowed for,) to correspond to her motions, and to have a particular reference to her phases, and the position she is in with regard to the earth.

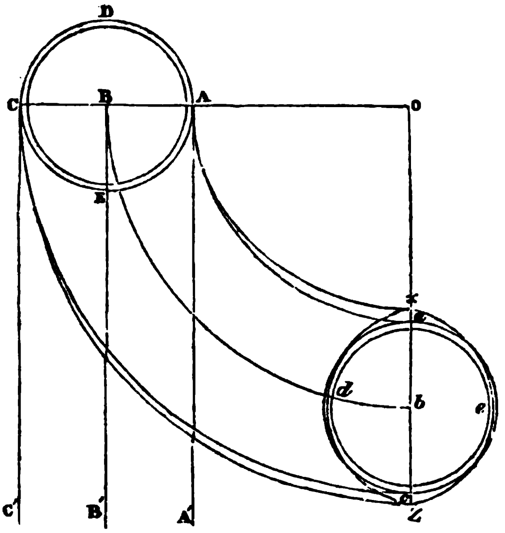
We may therefore, in the first place, consider the effect of the moon alone in producing the *general phenomena* of the tides, in obedience to, and under the control of that ever-active principle of universal gravitation, by which all the great bodies of the solar system, and indeed all the bodies and particles of matter in the universe, tend towards or mutually attract one another.

The power with which any body attracts any other distant body, is, directly as the quantity of matter of which the attracting body consists, and inversely as the square of its distance from the body attracted. As therefore, agreeably to this law, the power of gravity combined with the centrifugal force, carries the moon round the earth in its orbit, and prevents it from falling to the earth, so do these united powers, cause the earth to revolve in an orbit, and prevent it from falling to the moon, and that point between the centre of these two bodies round which they naturally revolve, is called their common centre of gravity, and is as much nearer to the earth than it is to the moon, as the quantity of matter contained in the former, exceeds that contained in the latter, and as the earth is supposed to contain about 40 times the quantity of matter which is contained in the moon, the distance of their common centre of gravity from the earth's centre, towards the moon, will be less than the earth's diameter, or something less than its semi-diameter from its surface in the same direction.

These things being understood, the true cause of the rise of the waters, immediately below the moon under the opposite side of the earth, may be easily explained.

Let A D C E be the earth, (supposed to consist of a spherical nucleus entirely covered by the waters of the ocean) and O the common centre of gravity of the earth and moon, round which the earth will revolve in the same manner, as if it were acted upon by an attracting body in that centre.

Now, all motion being naturally rectilinear, let AA'; BB'; CC'; be



the directions in which the points A, B, C, would respectively move, if not acted upon by any central body; also let B*b* be the orbit into which the centre of the earth is deflected from its tangential direction BB′.

Since the attractive force exerted upon the waters at A is as much greater than that which influences the centre of the earth at B, as the square of O A, is less than the square of O B, they must be deflected farther from their tangential direction, AA′, than the centre B, of the earth, and instead of describing the orbit A*a*, they will describe the orbit A*x*.

In the same manner the waters at C, being acted upon by a force as much less than that which influences the centre of the earth, as the square of OC, is greater than the square of OB, they cannot be deflected as much from their tangential direction CC′, as the centre B of the earth, and therefore describe the orbit C*z*, instead of the orbit C*c*.

Hence an accumulation of waters takes place at the point *x*, in consequence of their rising towards the moon, and a similar accumulation takes place on the opposite side of the earth at *z*, in consequence of their being as it were left behind, or being less deflected, than those about the other parts of the earth, from that rectilinear direction in which all bodies, if acted upon by a projectile force alone, will move; while the waters about *dbe*, or 90° distant from the highest elevations will sink, both in consequence of their own weight being increased, and because some part of the waters of those places must be drawn off, to supply the accumulation about *x* and *z*; the sea therefore (supposed to cover the whole earth) will become an oval or oblong spheriod *dxez*, whose axis produced, passes through the moon and therefore if the moon had no *real* motion of her own in her orbit, but only an *apparent* motion arising from the rotation of the earth about its axis, this spheriod always having its longer axis directed towards the moon, and following her in her apparent revolution about the earth, would cause two floods and two ebbs in twenty four hours; but because she has a proper motion of her own, from west to east in her orbit, she comes to the meridian of any place about three-quarters of an hour later than she did the day before, and therefore makes two tides of flood, and two of ebb in about twenty-four hours forty-eight minutes.

We have hitherto considered the moon as the only agent concerned in producing the tides; the sun however, on account of his great magnitude, exerts considerable influence on the waters of the ocean, and has therefore a very sensible effect in producing these phenomena, yet by reason of the very small proportion that the earth's semidiameter bears to the immense distance of the sun from the earth's centre, his disturbing force, compared with that of the moon, is only in the ratio of 3 to 5; and hence the solar tides may be regarded as merely increasing or diminishing the tides, caused by the action of the moon.

Thus when the moon is new or full, that is when the sun and moon are either in conjunction with or in opposition to each other, they act in the same right line, and as each tends to raise the waters immediately under and opposite to itself, their conjoint effect is the same in both cases, producing what are called *spring tides*, but when the moon is in quadrature, the sun and moon acting at right angles to each other, their effects are completely opposed, and the flux and reflux instead of being augmented, become diminished, and these are called *neap tides.*

According to what has hitherto been said, the tides ought to be the highest immediately under the moon, and on the opposite side of the earth, yet observation proves that the time of high water at any place, never happens at the instant of the moon's passing the meridian of that place, but mostly some hours later; neither do the spring and neap tides take place when the moon is in syzigy or in quadrature, but generally a few days afterwards.

This difficulty admits of a very easy solution, for the moon's attraction having communicated a motion of ascent to the waters before her arrival at the meridian, they would continue to rise, even were her influence altogether to cease when she was past that meridian, much more therefore must they do so, when the attraction is only triflingly diminished, as a small impulse given to a body already in motion, will cause it to move farther than it otherwise would have done. For the same reason, we find that although the earth's orbit is elliptical, and the earth is in perihelion or nearest the sun in January, yet we have not the highest tides at that time, but some weeks later.

Generally however the tides are highest a little before the vernal equinox, and a little after the autumnal; as therefore the moon's orbit is also elliptical, when the moon is in perigee or nearest the earth at the time of her conjunction or opposition in February and March, or in September and October, the tides will be very considerably augmented.

The above may be considered as a very concise view of the theory of the tides in general, it will however, be absolutely necessary, to consider these phenomena, under certain modifications, principally arising from the obliquity of the ecliptic, and the inclination of the moon's orbit to the plane of the equator,

When the moon is vertical to the equator, the tide that happens when she is above the horizon, is of the same height with the next which takes place when she is below it. But as the moon declines from the equator, one of the elevations of the water constantly following the moon, while the other recedes from the equator on the contrary side, the former will describe nearly that parallel to which she is vertical, the latter will describe a parallel, as far distant from the equator in the opposite hemisphere.

Thus, the two elevations describe parallels of equal latitudes, but of different denominations,

Now if we suppose any place to be situated in north latitude, it is obvious that the elevation which moves in the northern hemisphere, will come nearer to that place, than the elevation which describes a parallel in the southern hemisphere, and since it is high water at any place, when either of these elevations passes the meridian of that place, it follows, that the tide produced by one of these elevations, must differ in magnitude from that produced by the other, and that the highest tide will be caused by that elevation which moves in the same hemisphere in which the place is situated.

When, therefore, the moon and the place of observation are both on the same side of the equator, the tide which takes place while the moon is above the horizon of that place, exceeds that which is produced when she is below it, because the elevation which immediately follows the moon, moves on the side of the equator with the place.

When the moon and the place of observation are on opposite sides of the equator, the elevation which is opposite to the moon, moves on the same side with the place, consequently the greater tide is produced when the moon is below the horizon, and the smaller happens when she is above it.

The difference between the two tides ought, therefore, to increase with the distance of the disturbing forces from the equator, and to be greatest when the sun and moon are in the tropics, because the two elevations then describe the two circles, which are most distant from each other, and observation shews that in summer the evening tides are higher than the morning, but in winter the morning tides are higher than the evening.

We have hitherto supposed the surface of the globe to be entirely covered with water, this however, not being the case, the doctrine of the tides as now explained, can at best only apply to the tides in the ocean, nor will they be found even then altogether to accord with the general theory, since to produce the daily vicissitude of high and low water, would require a longitudinal extent of at least a quadrant of the ellipse.

All the phenomena therefore which have been described, will be greatly modified by the direction of the shores, the extent of the seas, the width and direction of the channels through which the waters pass, the setting of currents by winds, and other local circumstances: thus it is found that in confined seas, such as the Euxine, the Baltic, and also in lakes of great magnitude, such as those in North America, the rise of the waters, is so trifling as to be almost insensible, and even in the Mediterranean, although a sea of considerable extent, the elevation is very small, owing to the narrowness of the passage by which it communicates with the ocean.

We shall however forbear any further remarks upon tides in particular places, which to be useful, must be carried to an extent altogether incompatible with the nature of the present work, and shall merely observe that although these local tides are sometimes found to be such, as even to seem to contradict the general theory here laid down, they will be found upon a minute investigation, to be perfectly conformable to that theory, the apparent irregularities being produced by some of these modifying circumstances already alluded to.

The method of computing the time of high water at any place by the supposed bearing of the moon, at that time, is too defective in itself, and founded upon principles too inaccurate to merit any particular description.

Notwithstanding the causes of derangement already alluded to, the time of high water at any place may, in general, be found with sufficient exactness for the practical purposes of navigation, by the following rules and observations.

The method commonly practised at sea for finding the time of high water on a given day at any proposed place, is to add the time of high water at the given place on the full and change days, (T. 43,) to the time of the moon's meridional passage on the proposed day, their sum is taken as the time of high water at that place on the given day. If this time exceed 12h. 24m. (which is the mean interval between each succeeding tide.) or if it exceed 24h. 48m. those quantities are respectively taken from it, and the remainder is assumed as the apparent time of high water in the afternoon of the given day, from which the mean time is found by applying the equation of time (N.A.p.I.) as usual.

When this method is adopted, the time of the moon's passing the meridian is generally deduced from the *moon's age*, obtained by means of the *epact for the year*, and the *number for the month*; the former of which is most correctly found by the aid of the *golden number*. Now, the moon's age thus found will frequently be above a day, and the time of her passing the meridian more than an hour wrong, for which reason, and also because the effect of the sun's attraction in accelerating the tides in the first and third quarters, and retarding them in the second and fourth, is in this method totally disregarded, we shall after very briefly explaining the several particulars above-mentioned, and how they may be found, proceed to give a method of solving this problem, which, except under peculiar circumstances of wind, &c. will generally be within a very few minutes of the truth.

THE GOLDEN NUMBER.

Is any number of the *lunar cycle,* that is, of a period of nineteen years, after the expiration of which the new and full moons fall on the same day of the month as they did at the beginning of that period.

To find the golden number for any year.

RULE.—Add 1* to the year, and divide the sum by 19, the remainder is the golden number. If there be no remainder the golden number is 19.

Example.—What is the golden number for the year 1852?

1852 + 1 ÷ 19 = 97 and 10 remainder, which remainder is the Golden Number.

THE EPACT.

Is the moon's age at the beginning of the year; that is, the number of days which have elapsed since the last new moon in the preceding year.

To find the Epact for any year till 1900.

RULE.—Find the golden number and subtract 1 from it, multiply the remainder by 11, and the product will be the epact:—if the product exceed 30, divide it by 30 and the remainder will be the epact.

Example.—What is the Epact for the year 1852.

The Golden Number as before found is 10.

Hence (10 − 1) × 11 = 99 and this divided by 30 = 3 and 9 remainder, which remainder is the epact for 1852.

THE NUMBER FOR THE MONTH.

The number or epact for the month, is the moon's age at the beginning of that month, when it is new moon on the first of January.

To find the number for any given month.

Divide the number of days contained in the preceding months, reckoning from the beginning of January, by 29·53, the period of a mean lunation (or 29d. 12h. 44m. expressed in days and decimal parts) and the nearest whole number to the remainder, is the number for the given month.

Example.—What is the number or epact for May?

129 ÷ 29·53 = 4 and 1·88, or nearly 2 remainder; therefore the epact or number for May is 2.

What is the number or epact for July, 1852?

The number of days from 1st January to July = 182.

Hence, 182 ÷ 29·53 = 6 and 4·82 remainder, which remainder 4·82 or 5, is the epact or number for July, it being leap year.

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* The Golden Number was 1 at the birth of Christ.

The numbers or epacts for the several months, found by the foregoing rule, will be as follows :

	Jan.	Feb.	Mar.	April,	May,	June,	July,	Aug.	Sept.	Oct.	Nov.	Dec.
Common Years ..	0	1	0	1	2	3	4	5	7	7	9	9
Leap Years......	0	2	1	2	3	4	5	6	8	8	10	10

The year, according to our present mode of reckoning, consists of 365 days for three years together, and every fourth year consists of 366 days; this last is a leap year, in which the month of February has 29 days. But the centuries which will not divide evenly by 4, such as 1700, 1800, and 1900, are not accounted as leap years.

The Moon's Age.

Is the time elapsed since the last new moon; it is commonly reckoned in whole days, and can of course never exceed 30.

To find the Moon's age.

Rule.—Add together the epact for the year, the number for the month and the day of the month, their sum, if it does not exceed 30, is the moon's age, if it does, subtract 30 from it, and the remainder will be the moon's age.

Example.—What will be the moon's age, July 17, 1852 ?

The epact already found is 9.
Hence $9 + 5 + 17 = 31$, and $31 - 30 = 1$, the moon's age.

What will be the moon's age, April 14, 1852?
Answer,—25 days.

To find the time of High Water, on a given day, at any place (very near the truth,) *the time of high water at that place at full and change of the moon being known.*

Rule.—Reduce the time of the moon's meridional passage in *mean* time, taken from page IV of the month in the Nautical Almanac, to the time of her meridional passage at the given place, by Table 21.

With this time corrected by the equation of time to the nearest minute taken from page II of the month in the Nautical Almanac, and the moon's semi-diameter from page III of the month, take out the corresponding correction from Table 42, which add to the above time, or subtract from it, as directed in the Table.

To the sum or remainder add the time of high water at the given place on full and change days, Table 44, and the sum will be the time of high water in *mean* time past noon of the given day.

But if this sum exceed 12h. 24m. or 24h. 48m. subtract those times respectively from it, and the remainder will be the time of high water, within a few minutes of the truth, in the afternoon of the given day, from which the time of high water on the preceding morning may be found by subtracting 24 minutes from it, or on the following morning by adding 24 minutes to it.

Example.—Required the time of high water in mean time at Cape Sable, Nova Scotia, in longitude 65° 34′ 3″W. on June 24, 1852.

	h	m
Moon's mer, pass. in mean time at Greenwich, June 24, by Nautical Almanac, page IV of the month	6	3
Correction to daily variation 50m. and long. 65° 34′W. (T.21)	+	9
Moon's mer. pass. in mean time at Cape Sable	6	12
Correction to 6h. 12m. + equa. time 2m. = 6h. 14m. and moon's semidiameter at 6h. P.M. 16′ 5″ (T. 42)	—	58
	5	14
Time of high water at Cape Sable, on full and change days (T. 43)..	7	45
	12	59
Average time of a tide..................................	12	24
Time of high water at Cape Sable, June 24, 1852, P.M	0	35
	—	24
Time of high water at Cape Sable, in mean time, on preceding morning....	0	11
Time of high water at Cape Sable, in mean time, on following morning	0	59

Examples for Exercise.

Required the time of high water in mean time at Morlaix, France, in longitude 3° 54′W. on 1st. April, 1852.

Answer.—3h. 14m. P.M.

Required the time of high water in mean time, at Trincomale, Ceylon, in longitude 81° 13′E. on Sept. 4, 1852.

Answer.—9h. 4m.

Required the time of high water in mean time at Quidal Point, west Coast of America, in longitude 74° 15′W. on Nov. 14, 1852.

Answer.—1h. 10m.

The time of high water on a given day, at any place being known, to find the time of high water at that place on the full and change days of the moon.

RULE.—Proceed as in the foregoing rule to reduce the time of the moon's meridian passage, on the given day, found in page IV. of the month in the Nautical Almanac, to the meridian of the given place, by (T. 21.) Also correct this time as before, by (T. 42) and subtract the result from the observed time of high water in mean time of the given day, and the remainder will be the time of high water at the given place on full and change days.

If the time to be subtracted be greater than the observed time of high water, from the time of the moon's meridian passage over the given place, subtract half the difference of two successive passages, and then proceed as before, adding 12 hours to the observed time of high water, and should the time to be subtracted be still the greater, take the whole difference of two successive passages from the time of the moon's passing the meridian of the place, and proceed as before, adding 24 hours to the observed time of high water.

Ex.—If at Philadelphia in longitude 75° 10′ 30″W. on March 4, 1852 the observed time of high water should be 2^h 43^m P.M. what would be the time of high water on full and change days of the moon at the same place.

	h	m
Moon's meridional passage in mean time at Greenwich, on 4th March, by Nautical Almanac, page IV	11	9
Cor. to daily variation, 54m. and long. 75° 10′ 30″W. (T.21)	+	11
Moon's mer. pass. in mean time at Philadelphia	11	20
Half the diff. (56m.) of passages on given and following days	—	28
	10	52
Cor. to 10h. 52m.—equa. time 11m. = 10h 42m. and moon's semidiam. at midnight 16′ 30″ (T.42)	+	26
	11	18
Observed time of high water in mean time + 12 h.	14	43
Time of high water at Philadelphia, on full and change days	3	25

Example for Exercise.

Suppose at Oporto, longitude 8°40′W. July 25, 1852, the observed time of high water should be 3^h 50^m P.M.; what would be the time of high water on full and change days of the moon, at the same place.

Answer.—9^h 32^m.

Miscellaneous Questions for Exercise.

1—March 20th. 1852, longitude 40°E. the observed meridian altitude of $\underline{\odot}$ 60° 10′ 30″N. index error +30″, eye 18 feet; required the latitude ?

Answer.—29° 38′ 43″S

2—Sept. 22, 1852, long. 172° 30′W. the observed meridian altitude of $\underline{\odot}$ 89° 30′ 30″, sun S. of observer, index error —1′ 2″, eye 24 feet; required the latitude ?

Answer.—0° 18′ 37″N.

3.—July 11, 1852, P.M. at ship, latitude by account 27° 3′S, longitude 17° 38′W. the observed altitude of $\underline{\odot}$ near meridian 40° 30′ 20″, observer S. of the sun, index error — 1′ 23″, eye 24 feet, time by watch 10th. day $23^h\ 10^m\ 47^s$, which had been found $1^h\ 8^m\ 7^s$ slow for apparent time at ship; and since the error for apparent time had been determined, the ship had made 8½′ longitude to E.; required the latitude ?

Answer.— 27° 3′ 31″S.

4.—Jan. 14, 1852, P.M. at ship, latitude by account 22° 51′N, longitude 33° 3′W, observed altitude $\underline{\odot}$ near meridian 45° 20′, sun south of observer, index error + 30″, eye 17 feet, time by watch 14th. day $2^h\ 33^m\ 50^s$ which had been found $2^h\ 15^m\ 30^s$ fast for apparent time at ship; but since the error for apparent time had been ascertained, the ship had made 7′ longitude to E.; required the latitude ?

Answer.—22° 50′ 41″N.

5.—October 21, (22nd. civil time.) 1852, A.M. at ship, latitude by account 15° 21′N. longitude 41° 10′E. observed altitude $\underline{\odot}$ near meridian 62° 10′, observer north of sun, index error + 1′ 10″, eye 26 feet, time by watch 22nd. day $0^h\ 10^m\ 10^s$ which had been found $40^m\ 50^s$ fast for apparent time at ship, but since the error for apparent time had been determined, the ship had made 10′ longitude to West; required the latitude ?

Answer.—15° 21′ 20″N.

6.—Nov. 11, (12, civil time) 1852, A.M. at ship, latitude by account 50° 40′S. longitude 54° 29′W. observed altitude $\underline{\odot}$ near meridian 56° 10′, sun N. of observer, index error —1′ 27″, eye at 19 feet, time by watch $12^d\ 3^h\ 10^m\ 40^s$, which had been found $3^h\ 49^m\ 30^s$ fast for apparent time at ship, and since the error for apparent time had been ascertained, the ship had made 13½′ longitude to E.; required the latitude ?

Answer. -50° 40′ 17″S.

7.—March 20, 1852, P.M. at ship, latitude 40° 20′S. observed alt. $\underline{\odot}$ 30° 20′, index error +30″, eye 18 feet, time by chronometer $19^{d}\ 20^{h}\ 30^{m}$ which was $24^{m}\ 29^{s}$ fast on mean time Greenwich, noon February 13, and losing $7{\cdot}5^{s}$ daily; required the longitude?

Answer.—107° 40′ 15″E.

8.—June 19, (20, civil time) 1852, A.M. at ship, latitude 29°N. observed altitude $\underline{\odot}$ 40° 50′ 20″, index error +1′ 8″, eye at 20 feet, time by chronometer $20^{d}\ 6^{h}\ 20^{m}\ 40^{s}$, which was $10^{m}\ 38^{s}$ slow on mean time Greenwich noon June 16, and gaining $4{\cdot}2^{s}$ daily; required the longitude

Answer.—152° 8′ W.

9.—December 23, 1852, P.M. at ship, latitude by account 8° 22′S. longitude 12° 11′E. observed altitude $\underline{\odot}$ near meridian 74° 4′ 6″, observer N. of sun, eye 18 feet, time by watch $22^{d}\ 23^{h}\ 59^{m}\ 50^{s}$, which had been found $20^{m}\ 31^{s}$ slow for apparent time at ship, and since the error for apparent time had been determined the ship had made 24′ longitude to W.; required the latitude?

Answer.— 8° 22′S.

10.—April 4, 1852, P.M. at ship, latitude 39° 27′S. observed altitude $\underline{\odot}$ 29° 51′ 35″, index error +3′, eye at 18 feet, time by chronometer $4^{d}\ 0^{h}\ 14^{m}$, which was $13^{m}\ 10^{s}$ slow on mean time Greenwich, Jan. 25, and losing 5^{s} daily; required the longitude?

Answer.—34° 59′ 15″E.

11.—August 31, (September 1, civil time) 1852, A.M. at ship, latitude 33° 1′N. observed altitude _ 27° 8′ 10″, index error +1′ 45″, eye 18 feet, time by chronometer $31^{d}\ 18^{h}\ 0^{m}\ 0^{s}$ which was $15^{m}\ 25{\cdot}6^{s}$ fast on mean time Greenwich noon, August 7, and losing $5{\cdot}6^{s}$ daily; required the long.?

Answer.—30° 34′E.

12.—Required the apparent time of the rising and setting of the sun August 4, 1852, in latitude 36° 42′N. and longitude by account 50W.

Answer.—True time of rising of the Sun's centre, $5^{h}\ 6^{m}\ 38^{s}$.
Setting - - - - - $6^{h}\ 55^{m}\ 54^{s}$.

13.—June 25, 1852, at $7^{h}\ 14^{m}$ P.M. apparent time at ship, latitude 36°N. longitude 16° 30′W. the sun's setting amplitude was observed to be W. 43° 27′N. required the deviation of the compass?

Answer.—14° 4′W.

14.—May 3, 1852, at 3^{h} P.M. mean time at ship, latitude 1° 10′S.

longitude 0, the observed altitude $\underline{\odot}$ was 41° 23′ 31″ bearing N. 49° 20′W. height of eye 19 feet, required the variation of the compass?

Answer.—18° 7′W.

15.—Find the course and distance from Cape Formosa, lat. 4° 15′N. longitude 6° 11′E. to St. Helena latitude 15° 55′S. longitude 5° 45′W.?

Course S. 30° 20′ 47″W. Distance 1402 miles.

16.—Find the course and distance from Bahia latitude 13°S. longitude 38° 32′W. to Fernando Po, latitude 3° 48′N. longitude 8° 43 E.

Course N. 70° 18′E. Distance 2991 miles.

17.— 1st of May 1852, in lat. 48° 30′N. and longitude by account 35° 15′W. when a chronometer, correct for Greenwich mean time, told 9^h 30^m 32^s, the sun's lower limb, at setting, was observed to be 20′ above the *visible* horizon of the observer, the height of the eye being 18 feet; required the true time at ship, and the true longitude from Greenwich?

Answer,—Long. 35° 22′ 7·5″W.

18—1852, November 3, A.M. at ship, the following observations were made upon the sun-rising, by a chronometer which was correct for Greenwich mean time on the 10th. of October preceding, *at noon*, and which was gaining $7{\cdot}36^s$ daily:—November 2, 1852. *astron. time,*

	h	m	s
sun's upper limb, at horizon, rising	8	24	16
sun's centre „	8	26	33
sun's lower limb „	8	28	44
sun's centre *rising* (mean)	8	26	31

The ship's latitude at the middle time of these observations, was 35° 56′ 45″S. and the height of the eye, 16 feet, required the longitude when the sun's centre was at the horizon?

Answer.—Longitude at ship, 127° 53′ 48″E.

19—June 12, 1852, at 11^h 29^m 31^s, by a chronometer which was correct for Greenwich mean time, on the 1st May last, but which was losing $1{\cdot}56^s$ per day; the sun's *centre* was observed at the horizon, *setting*. The latitude, found by the sun's meridian altitude on the same day, and corrected for the ship's run, was 58° 36′ 40″N. she was in long. 35° 45′W by account, and the height of the observer's eye was 20 feet above the level of the sea; required the true longitude of the ship, at the time of observation?

Answer—Longitude 36° 10′ 34″W.

WINDS.

On the Currents of the Atmosphere.

It has been before remarked p. 154 that the earth is surrounded with an atmosphere, and that this elastic fluid is the scene of many interesting phenomena; it revolves with the earth, and of course increases in velocity with the distance from the axis of revolution. There is a point where the centrifugal force, that is the tendency to fly off from the centre, will counterbalance the centripetal, or gravitation towards the centre, and it is therefore obvious that no portion of the atmosphere can extend beyond that point where the two influences are in equilibrium.

The indications of the height of the atmosphere, as shewn by a barometer, place its elevation within very narrow limits. A column of air is nearly equal in weight to a similar column of mercury of thirty inches, or of water of thirty four feet, which would give it an elevation of about five miles, if its density were equal, but the elasticity of the air, causes it to expand with the diminution of its own pressure, which becomes less at every step from the surface of the earth.

It is well known that the temperature diminishes with its height, and therefore the higher a body ascends, the greater is the quantity of heat abstracted from it, the surrounding atmosphere becoming more rarified; thus may be accounted for, the perpetual snows which crown the tops of mountains, whilst perpetual sunshine plays around them, and whilst the most luxuriant cultivation clothes their base, and all nature basks in the torrid heat of the tropics.

Winds are but the atmosphere put in motion, and these agitations of which we witness both the violent and gentle, proceed either from a change in the temperature of a portion of the air, or from a change in the quantity of water which it holds in a state of vapour; when any portion, therefore, of the earth's surface is more heated than the surrounding parts, the air ascends and spreads through a cooler strata, causing an upper outward current, while the cooler fluid rushes toward the spot where the balance has been lost by expansion, and a strong current is produced.

These currents far surpass in velocity those of the ocean, and produce phenomena of which it will only here be possible to hint at, referring the pupil for full information on the interesting subject, to the works of Col. Reid, the father of a theory, which deserves the endless gratitude of the Navigator; and who, by unwearied observation and ceaseless enquiries on the subject, has reduced his observations to such practical rules, that the Navigator, when lucklessly overtaken by the wild, overwhelming Cyclones, (a name given to those rotary storms, from the snake-like coil they make in their progress,) may be able to trim his vessel to meet the shock, and steer out of a peril, only to be comprehended by those who have navigated those seas where they usually prevail. I would therefore strongly recommend Col. Reid's works,* to those interested in the investigation of the subject, for a full account of these storms; the nature of this volume only allowing a slight sketch of the subject, which is humbly offered as an incitement to further and more satisfactory research.

TRADE WINDS.

It is supposed this name is given to certain winds which prevail in the tropics and a few degrees north and south of them; their direction is from the north-east, north of the equator, and from the south-east, south of the equator; they are separated from each other by a region of calms, where thick, foggy air prevails, with frequent rains, attended by thunder and lightning; they generally extend more on the northern side of the equator than on the south, seldom reaching beyond a few degrees on the south side, and varying in breadth between 3 and 10 degrees.

When the sun is on the north of the equator, and approaches the tropic of Cancer, the north-east trade wind extends to 32°N. latitude, and the wind is more easterly, but the parallel of 25° is its N. boundary. The wind inclines more north when the sun approaches his most southern declination; at this season the southern boundary of the south-east trades extends to about 30°S. latitude, and continues to about 2°N. of the line. The general width of the south-east trade wind is about 9° greater than the north-east, owing to the region of calms almost wholly lying on the north of the equator, and in the Atlantic, these winds have a more easterly direction, sweeping the very coasts of America.

The African coast is nearly free from their influence, from causes easily explained, were it necessary to enter here more fully into the subject. What formerly was looked on with astonishment and wonder by early navigators, is now solved by the careful investigation of nature, and her inviolable laws. The mind of man, borne on the wings of science, has explored her hidden mysteries, and the navigator now pursues his trackless path, with confidence and perfect security, under the guiding influence of extended knowledge.

The trade winds extend over that surface of the earth which is heated by a vertical sun, and the air becomes rarefied and expanded; the consequence is, that bodies of air are constantly buoyed up from the surface, and the upper strata flies off towards the poles, where it is cooled and again descends and rushes back to supply the place of that which has been undergoing the same process of rarefaction; thus a continual current of upper air is kept up towards the poles, and were the Earth at rest, there would be an under current from the poles to the equator, but as the velocity of the earth's motion on her axis, is greater at the equator than in northern and southern latitudes, the air in its progress from the pole to the equator, will meet with an increased velocity in the earth's motion, and not acquiring at once this increased velocity, falls off towards the west, and hence what would be either a north or south wind, becomes a north east or south east wind, as it approaches the equator, or those regions where the velocity of the earth is the greatest.

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* "An attempt to develope the Law of Storms;" and "The progress of the Developement of the Law of Storms, with the practical application of the subject to Navigation."

But the winds which the Navigator has most cause to dread, and the theory of which Col. Reid has reduced to such practical application, are the hurricanes or whirlwinds, which burst across his path at the rate of from 3 to 43 miles an hour; the circles at the commencement of this volume, kindly distributed by Col. Reid for the use of the Navigator, will shew how these gales revolve in each hemisphere, and if placed on a chart, will serve "to aid the memory whilst considering how the wind veers in whirlwind storms."

"For example, in the diagram the trade wind is supposed to be blowing from the east-north-east, whilst a whirlwind hurricane is moving towards Barbadoes from the eastward, as shewn by a spear head. By moving such a circle onwards in the same direction, until it reaches Barbadoes, the arrows of the storm circle will then represent the wind in the hurricane, as setting in at north-by-east. If the centre circle be moved over Barbadoes, the arrows on the opposite side of the circle will represent the wind of the hurricane as ending at south by west."*

It is supposed that in the tropics near the equator, the storms or Cyclones, as they are now generally called, move nearly direct from the east towards the west, in a northerly direction, in the northern hemisphere, and in a southern direction on the south side of the equator, until they arrive about the latitude 20°, when they again curve towards the east.

The rate at which these storms travel, varies considerably in different parts of the world; according to Mr.Redfield's remarks, the highest rate at which the West Indian and North American storms travel, is about 43 miles an hour, and the lowest about 9 miles, but in the Indian Ocean, their rate of travelling is not greater than 9 to 10 miles an hour, and in the Bay of Bengal, the average rate may be taken at from 3 to 15 miles; some of the most violent hurricanes have, however, progressed even at a diminished rate of 2½ miles an hour.

These revolving storms sometimes extend over a wide space occasionally contracting and dilating in their progress, and have been known to increase from 50 to 600, and sometimes 1000 miles in diameter, but as it would be impossible in a work of this sort, to enter fully into such a subject, I will close these few remarks, given with a view to awaken the attention of the Navigator, by making the following extract from Col.Reid's work, who has kindly given me casts of the accompanying figures to illustrate his rules for

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* The progress of the development of the Law of Storms, by Col. Reid, chap. 1, p.3.

Laying Ships to in hurricanes,

"That tack on which a ship should be laid-to, in a hurricane, has hitherto been a problem to be solved, and is one which seamen have long considered important to be explained.

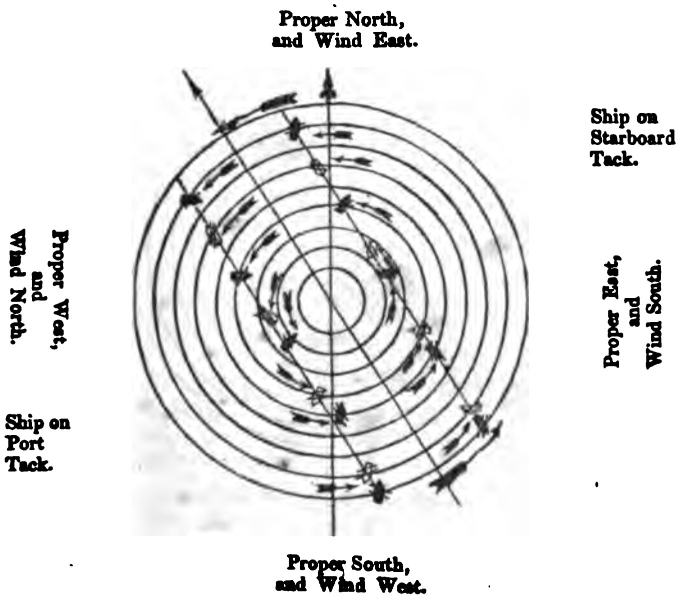
In these tempests, when a vessel is lying-to, and the wind veers, by the ship's head, she is in danger of getting stern-way, even when no sail is set; for in a hurricane, the wind's force upon the ship's masts and yards alone, will produce this effect, should the wind veer a-head; and it is supposed that vessels have often foundered from this cause.

When the wind veers aft, as it is called, or by the stern, this danger is avoided; and a ship then *comes up* to the wind, instead of falling off from it.

In order to define the two sides of a storm, that side will be called the right-hand semi-circle, which is on the right of a storm's course, as we look in the direction in which it is moving, just as we speak of the right bank of a river. In the two next figures, the central track or courses are shown by spears, and their directions by the spear heads.

If it be desired to lay a ship to, in a revolving storm, so that she shall *come up* to the wind, instead of *falling off* from it, the rule will be, when in the *right-hand* semi-circle to heave-to upon the *starboard* tack, and when in the *left-hand* semi-circle to heave-to upon the *port* tack, in both hemispheres.

Figure for the northern hemisphere.


Proper North, and Wind East.
Ship on Starboard Tack.
Proper West, and Wind North.
Proper East, and Wind South.
Ship on Port Tack.
Proper South, and Wind West.

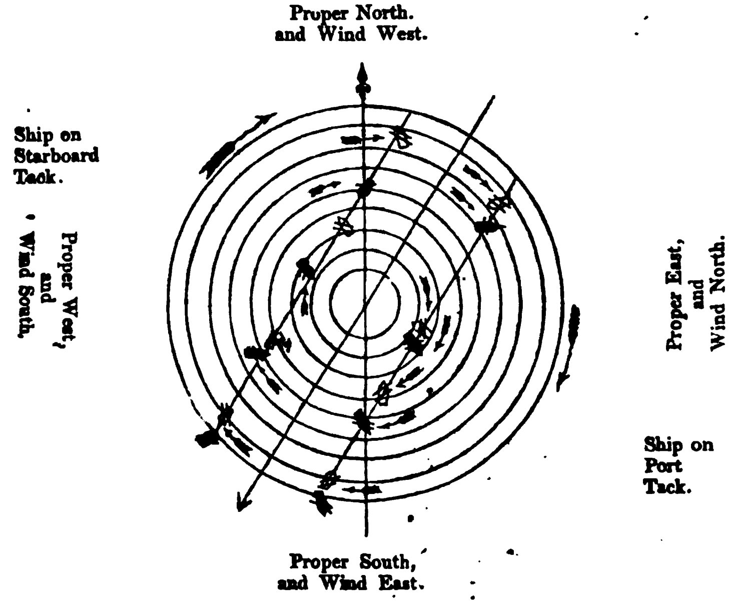
The first of these two figures is intended to represent one of the West Indian hurricanes, moving towards the north-west by north, in the direction of the spear drawn obliquely. The commander of a ship can ascertain what part of a circular storm he is falling into, by observing how the wind begins to veer; thus, in the first figure, the ship which falls into the right-hand semi-circle, would receive the wind at first about east-by-north, but it would soon veer to east, as the storm passes onwards; the ship which falls into the left-hand semi-circle, would at first receive the wind at north-east; but with this latter ship, instead of veering towards east, it would veer towards north.

The explanation of the rule will be best made out by attentively inspecting the two figures. In both, the *black* ships are on the tacks on which the ships will *come up* to the wind, the *white* ships on the tacks on which they will *fall off*.

The second figure is intended to represent one of those hurricanes in south latitude, which pass near the Mauritius, proceeding to the south-westward.

The whirlwind is supposed to be moving south-west-by-south, in the direction of the spear head. It will be seen that the *black* ships are always *coming up*, and the *white* ships always *breaking off;* and that they are on opposite tacks on opposite sides of the circles.

Figure for the southern hemisphere.


Proper North.
and Wind West.
Ship on Starboard Tack.
Proper West, and Wind South.
Proper East, and Wind North.
Ship on Port Tack.
Proper South, and Wind East.

This will be the rule for laying a ship to in a revolving gale, when it shall be desired that she shall *come up to the wind.*

From this rule it follows that, if two ships be hove-to within the compass of the same revolving gale, and on the same tack, and the one ship comes up, whilst the other falls off, the centre of that revolving gale will be passing between them.

This will assist in judging approximately of the track gales may be following, even in the case of single ships.

There are however, reasons for modifying this rule. If we look at the *black* ships in the *left* hand semi-circle, of the figure in the *northern* hemisphere, and in the *right* hand semi-circle, of the figure in the *southern* hemisphere, it will be seen that these black ships point with their heads towards the storm's centre; if they forge a-head, they will draw towards the storm's central track. It may therefore be preferable, as a *general rule*, when heaving-to in a revolving gale, to bring the ship to the wind on the *starboard*-tack, when on the *north* side of the equator, and on the *port*-tack, when on the south side of the equator; then will the ships, when shooting a-head, be gradually moving away from the storm's centre."*

The Progress of the Developement of the Law of Storms,
page 24, Col. Reid.

THE BAROMETER.

This useful instrument is of leading importance to the mariner, therefore a few remarks on its construction, property of measuring the weight of the air, and the variations of its pressure, in order to determine the changes in the weather, the heights of mountains, &c. may lead to a more careful examination of its fluctuations, and hence a better acquaintance with its great and useful qualities.

It was invented by Torricelli, an Italian, about the middle of the 17th century. He took a glass tube about 3 feet long, open at one end only, and having filled it with mercury, he placed the open end in a cup containing the same fluid metal, taking care that no air was admitted into the tube, and likewise that no metal escaped out of it. When the tube was raised perpendicularly, he found that a portion of the mercury descended into the cup,—the height of the column of metal in the tube being only about 30 inches,—from this he inferred that the atmosphere pressed on the surface of the mercury in the cup, and forced it up the tube to that height, *because a column of air from the cup to the top of the atmophere*, was only equal to the pressure arising from the *weight of a colum of mercury of the same base and* 30 *inches high.*

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* The Diurnal Register for Barometer, &c. published by me, is well adapted for the remarks of the Navigator, both as relating to the Winds, and state of the Atmosphere; the plan and method of keeping the registry are easy, and will save much trouble, a simple dot marking the state of the Barometer; a scale of numbers, denoting the force of the Wind, and letters of the alphabet, indicating the state of the Weather. This method is used in the Navy, and at the Observatory at Greenwich.

Several experiments were made by different philosophers, all tending to confirm the Torricellian principle; though to render the instrument fit for sea observations, the measurements of altitudes, &c. great alterations were obliged to be made, and the present Marine Barometer, when properly made, has arrived, by a succession of careful experiments, at such a degree of perfection as to afford the mariner the most satisfactory means of ascertaining the approaching atmospheric changes, and thus enables him to prepare for the sudden bursting of storms, to which he is so exposed in his path across the trackless ocean.

The law of storms is daily becoming more developed, not only by the investigations of the philosopher, but by the careful observations of some of our intelligent Navigators in the Merchant service, who, from experience, speak with the greatest confidence in the Barometer, as a sure indicator of approaching bad weather.

The changes of the weather seldom produce a variation in the height of the mercury, which passes the limits of 28 and 31 inches, which is therefore a sufficient length for the graduated scale.

Mr. Redfield's explanation* of the true cause of the fall and rise of the barometer, in gales of wind, is of the highest importance.

He says, "that a whirlwind which sets an extended portion of the atmosphere, into a state of rapid revolution, diminishes the pressure of the atmosphere over that portion of the earth's surface, and most of all at the centre of the whirl. The depth of the compressing column of air will, at the centre, be least, and its weight will be diminished in proportion to the violence of the wind."

This idea may be exemplified by taking a tumbler half-full of water, and after putting the water into rapid revolution, holding it up against a strong light; the surface of the water will be seen to be depressed in the centre of the whirl.

The liquid will serve to represent the atmosphere, and if the tumbler be moved over a fixed point, in the manner in which a progressive whirlwind gale would move over it, it will show how the barometer begins to fall as the storm sets in; how it continues to fall until the centre has passed, and afterwards rises and resumes its former level.

Col. Reid says, (page 19) that his own observations confirm the truth of this important explanation; he likewise observes, that great whirlwinds, by lowering the upper atmosphere, bring down portions of the colder regions of the air, and these mingling with the warmer and moister air at the surface of the sea, form dense clouds. In these gyrations it sometimes happens, that the barometer falls as much as two inches, diminishing the atmospheric pressure by $\frac{1}{15}$ part; and it may be expected, as a natural consequence, that very dense clouds should then be formed, such as seamen describe in tempests.

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* For Mr. Redfield's *scientific* explanation of the causes which produce the fall of a Barometer, on the approach of a storm, see page 19 of Col. Reid's Developement of the Law of Storms.

In the northern hemisphere within the tropics, the barometer usually falls with a northerly wind, because whirlwinds come from the eastward. But in the southern hemisphere, within the tropics, the barometer usually falls with a southerly wind, because, although whirlwinds there also come from the eastward, they revolve in a contrary direction south of the equator.

In both hemispheres, revolving gales blow with a west wind, on the side next the equator. In recurving, in both hemisphere, whirlwind storms will have a polar direction for a while; the barometer during that time, will begin to fall with easterly winds, but after they have recurved, and are moving easterly, the barometer will fall with southerly winds, in the northern hemisphere, and with northerly winds, in the southern hemisphere; but the above explanation has exceptions.

The words on the plates of the Barometer are not so strictly to be observed, as the rising and falling of the mercury, for if it stand at *Much Rain* and then rise to *Changeable*, it presages fair weather, though not to continue so long as though the mercury had risen higher; and so on the contrary, if the mercury stand at *Fair*, and then fall to *Changeable*, it presages bad weather, though not so much as if it had sunk lower.

From this it appears that it is not from the point at which the mercury may stand, that we are to form a judgment of the state of the weather, but from its being in a state of rising or falling; therefore it is necessary to attend to the following directions:

1st. If the mercury is in a rising state, it stands higher in the middle of the tube than at the sides.

2nd. If the middle be hollow, it indicates its fall.

3rd. If level, it is steady.

4th. Before observation gently tap the barometer near the top, as the mercury will occasionally, where the tubes are small, slightly hang to the sides of the glass, and prevent its predicting any very delicate change, which may have taken place in the air.

The following explanation of the scale and vernier, and examples to shew the manner of reading them, may be of use.

The scale is divided to inches and tenths, and again, by means of the vernier, subdivided into hundredths of an inch; the observations are therefore better made from the figures than the words.

Example, Suppose the mercury to stand *nearly a tenth* above 30, turn up the vernier till the top stands even with the surface of the mercury, and observe which of its divisions or figures exactly coincides with any one of the divisions on the barometer scale; suppose 9 on the vernier to agree with one of the lines, the height of the mercury as then shewn, will be 30 in. ·09, that is 30 inches and 9 hundredths of an inch from the level of its surface in the cistern.

Example 2. Suppose the mercury to stand a little below the 30, but not a tenth below, set the top of the vernier level with the mercury, and suppose 6 on the vernier to coincide with one of the lines on the barometrical scale, the height of the mercury will then be 29 in. ·96 (hundredths) or rather more than 9½ tenths above 29 inches.

The greatest height of the mercury is observed when an easterly or northerly wind prevails. Within the tropics, and near them, the changes and alterations in the weather make little or no variation in the height of the mercury. In the eastern seas, where sudden and violent storms are so frequent, the barometer is not found so sensitive as

THE SYMPIESOMETER,

which is now coming into very general use, and is considered by some to be more sensitive than the barometer, often predicting approaching storms several hours before hand, and the oil again beginning to rise when the gale has reached its height, even though it may continue to blow for some hours afterwards.

In this instrument a lively, elastic, confined gas is used, which presses on the confined surface of the liquid, with an uniform pressure at an equal state of temperature. The liquid is raised or depressed by increase or diminution of atmospheric pressure, and the change of temperature allowed for, by the sliding scale of the sympiesometer being always set to agree with the height of the mercury in the thermometer attached to the instrument, in the following manner; bring the *pointer* attached to the sliding scale of the sympiesometer, to the same degree on the inverted scale over which it slides, as is indicated by the attached thermometer, the height of the oil, as then shewn by the sliding scale, will indicate the pressure of the atmosphere.

Suppose the temperature marked by the thermometer to be 52, then slide the moveable scale until the *pointer* is over 52 on the inverted scale, and the top of the red fluid stands opposite the second division above the third tenth, higher than the number 30; the height at which the instrument then stands will be 30 inches 3 tenths and a half; the tenths are drawn longer to distinguish them from the half tenths, and the quarters still shorter than the halves; in some instruments the tenths are again subdivided to shew hundreds, but the above method is now usually adopted, as being sufficiently minute. The circular register at the bottom of the frame, is set by turning the division on it, corresponding to that indicated by the sympiesometer, to the index.

When the oil sinks, bad weather may be expected, and on the contrary when it rises, the weather will in general be fine. As the instrument is so delicate, great care should be taken in the construction, and likewise in adjusting the sliding scale to the change of temperature.

THE THERMOMETER

is an instrument used for measuring heat, formed on the principle, that the expansions of matter are proportional to the augmentation of temperature; a common thermometer, therefore, is merely an instrument in which very minute expansions of the mercury may be rendered perceptible; and in this way it is applied to ascertain the degrees of atmospheric heat and cold; of late years it has become of great use at sea, in ascertaining approaches to land, icebergs, sand-banks, &c. It is an instrument in too general use, to require a minute description of its construction.

A FEW BRIEF DIRECTIONS TO FIND THE PRINCIPAL FIXED STARS.

The most conspicuous Northern Constellation is *Ursa Major*, the Great Bear, in which are seven bright stars between the first and third magnitudes. The two stars in the body, most distant from the tail, are usually called the *Pointers*, from their pointing to the Pole star, distance 29°.

About 46° South from the Pole Star, and about 48° West of the northern pointer, bearing a little to the south, is *Capella*, and a line from the Pole Star through *Capella*, will pass through *Rigel*, distance from *Capella* 54°.

A line S.W. from *Capella*, will pass through the Pleiades, distance about 28° and nearly through *Menkar*, 23° distance from that nebulous cluster.

About 7½° E. b S. from *Capella* is *β Auriga*; nearly S.E.b.E. in a line between *Benetnasch*, (the Star in the point of the tail of the Great Bear,) and *Deneb* in the tail of the Lion, is *Cor Caroli*, distant from the latter 28°, and from the former 14½°; a line S.W. from *Cor Caroli* will nearly pass through *Arcturus*, distance 25°. About 19° E.N.E. of *Arcturus*, is *Alphacca*, the brightest star in the Northern Crown.

A line from *Arcturus*, through the Northern part of the Crown will point out *Vega* in Lyra, distance 59°. E.N.E. of *Vega*, is *a Cygni*; *Vega*, *aCygni*, with the bright star *a Aquilæ*, form nearly a right-angled triangle. *aAquilæ* is distant from *Vega* 34½°, and from *aCygni* 37½°.

From *αCygni*, in a N.E. direction, and distance 33°, is *βCassiopeia*, and to the southward of both stars, nearly at the same distance from both, is *Scheat* in Pegasus, forming a large triangle in the heavens.

A little to the south of *Scheat*, is *Markab*. Cassiopeia is a remarkable constellation, five bright stars in it, forming a kind of W, and they are nearly at the same distance from the Pole Star, as those of the Great Bear, on opposite sides.

A line from βCassiopeia, and passing αCassiopeia or *Schedir*, distance 5°, and forming the most southern angle of the W, and through *Almaach*, distance from *Schedir* 19½°, will lead to the little nebulous cluster Musca. About 13° W.S.W. of *Almaach*, is *Mirach*, both in Andromeda, nearly E. from *Almaach*, distance 12° is *Algol*. N.N.E. of *Algol* at 9½° distance, is *Algenib*, a line from *Algenib* through *Algol* will intersect Musca; *Algenib*, Musca, and the Pleiades, which are a little to the E. of Musca, will form a long triangle.

Fixed Stars in or near the zodiac.

Nearly S.E.b.E. from the Pleiades, distance 14°, is the bright red-looking Star *Aldebaran*. 16° in a S.E. direction from this star, is the beautiful Constellation of Orion.

Bellatrix one of the northern Stars, is 16° distant from *Aldebaran*, and *Betelguex* the other northern Star, distant 7½° from the latter; S.W. at 10° distance are three stars of the second magnitude, nearly in a line with each other, called Orion's Belt; a line from *Betelguex* through the middle Star in the belt, will pass close to *Rigel*, distance 19° from *Betelguex*.

A line S.E. through the three Stars in the belt, will cross *Sirius*, the Dog Star, one of the most brilliant in the heavens, at 23° distance from the centre star of the belt. N.E. of *Sirius*, distance 23° is *Procyon*. *Sirius*, *Procyon*, and *Betelguex* form an equilateral triangle, and these two first being of the first magnitude, are easily recognised.

A line from *Procyon* will intersect *Pollux*, distance 22½°; and 5° N.W. of *Pollux* is *Castor*; 37° from *Procyon* E. b. N. is *Regulus*. A line from *Procyon* through *Regulus*, will pass through *Deneb*, or βLeonis a little north of the same line is *Arcturus* 35° from *Deneb*; S.E. 35° from *Deneb* is *Spica*, these three last Stars nearly equidistant from each other, form a large triangle. A line from *Regulus* through *Spica*, will pass *Antares*, distant from the latter 45½°.

About 14° N.E.b.E. from *αAquilæ*, already mentioned, is the Constellation Delphinus, known by four bright stars close together. Nearly S.E. from *αAquilæ*, and distance 58½°, is *Fomalhaut*; a line from *αAquilæ* through Delphinus, will nearly cross *Scheat* at the distance 48½°. 13° S. from *Scheat*, is *Marcab*. 14° due E. from *Scheat*, is *Alpheratz*, and nearly directly S. of *Alpheratz*, distance 14° is *Algenib*

—these four bright stars forming a square. Nearly in a line between *Menkar* and the Pleiades is *Arietis*.

Southern Fixed Stars.

A line from *Aldebaran* through Rigel will nearly cross *a Colombæ*; distance from the latter 26½°, and a little further will pass *Canopus*, distance from Rigel 46°. *Canopus* is likewise nearly S. of *Sirius*, distance from it 36½°. A line from *Betelguex*, through *Sirius* and distant 73° from the latter Star, is the beautiful Southern Cross, consisting of four bright Stars. 10° E. from the centre of the Cross is *β Centauri*, and a few degrees further E. is *a Centauri*, both Stars of the first magnitude, and therefore easily distinguished. To the E. of *a Centauri*, about 42°, is Pavo, and about 40° E. of Pavo is *Achernar*.*

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* The PLANISPHERE AND DIRECTIONS, published by me for the use of the Navigator, will give further particulars and a more extended knowledge of the fixed stars, and their positions with respect to each other.

THE LOG BOOK, OR JOURNAL,

Should contain a correct register of all the various occurrences which take place on board of a ship, whether in port or at sea. That part of the log-book which relates to the transactions on board while the ship is in port, is called the *harbour work* or the *harbour log*. That which contains an account of the courses steered, winds, currents, making or shortening sail, and in short, all that concerns the navigation of the ship at sea, in order to determine her true situation at any required time, constitutes what is called the *sea log*. With the former therefore the navigator may, strictly speaking, be said to have little or nothing to do, his journal properly commencing at the time of what is called *taking his departure*,—that is of taking (at the time of leaving the land) the exact bearing of some point or place, the true latitude and longitude of which are known, together with the estimated distance of the said point or place from the ship. The former being obtained by compass, the latter is commonly estimated by the eye; it may however, be much more correctly ascertained by the following

TABLE

For finding the Distance of an Object, by two bearings and the Distance run between them.

Difference between Course and 2nd bearing, in Points.	Difference between the Course and First Bearing, in Points of the Compass.																
	2	2½	3	3½	4	4½	5	5½	6	6½	7	7½	8	8½	9	9½	10
3½	1·																
4	1·00																
4½	0·81	1·23															
5	0·69	1·00	1·45														
5	0 60	0·85	1·17	1·66													
6	0·54	0·74	1·00	1·35	1·85												
6½	0·49	0·67	0·88	1·14	1·50	2·02											
7	0·46	0·61	0·79	1·00	1·27	1·64	2·17										
7½	0·43	0·57	0·72	0·90	1·11	1·39	1·77	2 30									
8	0·41	0·53	0·67	0·82	1·00	1·22	1·50	1·87	2·41								
8½	0·40	0·51	0·63	0·76	0·92	1·09	1·31	1·58	1·96	2·50							
9	0·39	0·49	0·60	0·72	0·85	1·00	1·18	1·39	1·66	2·03	2·56						
9½	0·38	0·48	0·58	0·69	0·80	0·93	1·08	1·25	1·46	1·72	2·08	2·60					
10	0·38	0·47	0·57	0·66	0·76	0·88	1·00	1·14	1·31	1·51	1·76	2·11	2·61				
10½	0·38	0·47	0·56	0·65	0·74	0·84	0·94	1·06	1·19	1·35	1·55	1·79	2·12	2·60			
11	0·39	0·47	0·56	0·64	9·72	0·81	0·90	1·00	1·11	1·24	1·39	1·57	1·80	2·11	2·56		
11½	0·40	0·48	0·56	0·63	0·71	0·79	0·87	0·95	1·05	1·15	1·27	1·41	1·58	1·79	2·08	2·50	
12	0·41	0·49	0·57	0·64	0·71	0·78	0·85	0·92	1·00	1·08	1·18	1·29	1·41	1·57	1·76	2·03	2·41
12½	0·43	0·51	0·58	0·65	0·71	0·77	0·83	0·90	0·97	1·03	1·11	1·20	1·29	1·41	1·55	1·72	1·96

The Table * is to be entered with the number of points contained between the ship's head and the *first* bearing of the object at the top, and with the number of points, reckoned the same way, between the ship's head and the *second* bearing, at the side; the number in the table at the intersection of the two columns being multiplied by the distance run, is the distance from the object at the time the *last* bearing was taken.

Example.—The Eddystone bears N.W. and after running W. by S. 8 miles, it bears N.N.E.; the number of points between W. by S. and N.W. is 5, and that between W. by S. and N.N.E. is 11, then under 5 points at the top, and abreast of 11 points at the side, stands the number 0·9, which being multiplied by 8, gives 7·2 miles, the distance at the time of the last (N.N.E.) bearing.

If the bearings are observed to quarter points, the numbers may be taken out accordingly. This needs no example.

The bearing and distance of the place, from which the departure is taken, being estimated or computed, is set down in the column of remarks on the log-board, on which board the other courses and distances made during the day, are also entered in their proper columns. The setting and drift of currents, with the estimated effect of the swell of the sea, are also inserted in the column of remarks, which must likewise contain an account of the weather, and of every occurrence which may be deemed of importance, particularly of the variation of the compass. The lee-way is usually entered in a column appropriated for that purpose, unless, as is the practice on board some ships, the courses are corrected for lee-way by the officer of the watch, before he puts them down on the log-board. The particulars on the log-board are transcribed every day at noon, into the *log-book*, which is ruled and divided in the same manner as the log-board.

The lee-way is the angle which the line of the ship's apparent course makes with the line she really describes through the water, for when a ship is close hauled, and the wind blowing fresh, that part of its force which is directed against the hull and rigging, together with a considerable portion of its action upon the sails, tends to drive her immediately from the direction of the wind, or what is termed to lee-ward. But since the bow of a ship exposes less surface to the water than her side, the resistance will be less in the first case, than in the second, consequently, the velocity in the direction of her head, will in most cases be greater than in the direction of her side, and her real course will be between those two directions.

Now since the quantity of lee-way a ship makes, must greatly depend upon the trim of the vessel, the quantity of sail she is under, and a variety of other causes, no accurate rule can be laid down for determining at all times, the quantity of lee-way that ought to be allowed; the following are, however, the rules generally given for this purpose, independent of observation.

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* This Table is copied from the Nautical Magazine, a small work in monthly parts, highly deserving the attention of every Navigator, from the valuable information it contains on all subjects relative to maritime affairs, and likewise from its being a channel, through which the mariner may make known his discoveries for the benefit of his brethren from time to time.

1. When a ship is close hauled, has all her sails set, the water smooth, with a light breeze, she is supposed to make little or no lee-way.
2. When the top-gallant sails are handed, allow one point.
3. When under double-reefed sails, allow one point and a half.
4. When under close-reefed top sails, allow two points.
5. When the top-sails are handed, allow three points and a half.
6. When the fore-course is handed, allow four points.
7. When under the main-sail only, allow five points.
8. When under the balanced mizen or mizen-stay-sail, allow six points.
9. When under bare poles, allow seven points.

The foregoing allowances depending entirely upon the quantity of sail set, are from a variety of causes, well understood by the practical seaman, far too vague to be relied on.

The quantity of lee-way the ship makes, may be very accurately determined as follows, provided the ship be kept steady to the wind, during the operation.—Let a semicircle be described upon the taffrail with its diameter at right angles to the ship's keel, and its circumference divided into points and quarters, and having a low crutch or swivel in its centre. Then after heaving the log, the line is to be snatched into the crutch, just before it is drawn in; and the points and parts of a point, contained between the direction of the log line, and the fore and aft line of the semicircle, will be the lee-way.

When a contrary gale of wind, accompanied with a heavy sea, retards the progress of the vessel, the great aim will be (where circumstances will permit) to head-reach, or lay-to on that tack on which the vessel will bow the sea best, having sufficient sail set and trimmed, so as to keep her laying close by the wind, with the helm partly a-lee, or amid-ships: the nearer that the helm is amid-ships under such circumstances, the less liable it will be to receive damage, or to retard the vessel's progress.*

The tiller being now put partly over to lee-ward, brings the ship's head towards the wind, which then having little power on her sails, she loses her way through the water, and the directive power of the rudder consequently ceases, her head falls off from the wind, the sail which she has set, again fills, giving her fresh way through the water, which acting upon the rudder, brings her head again towards the wind; and she thus comes up and falls off alternately.

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* The practice of lashing the helm hard-a-lee is decidedly objectionable and dangerous in a sea-way; the helm ought never to be hove hard up or down, unless to avoid coming in collision.

The number of points upon which a ship comes up and falls off, depends greatly upon the sails under which she lies-to, and this must be governed by circumstances, since some ships will ly-to better under one particular sail than another; in lying-to under a close reefed top-sail and mizen-stay-sail, a ship generally comes up within five points, and falls off to seven, but under storm-stay-sails a vessel will come up to four, and fall off to seven points from the wind.

In recording a swell of the sea (a circumstance that should be carefully noted,) it is to be named after the point of the compass, *from* which the waves proceed; unless, which is perhaps preferable, the word "from," be introduced, thus, what is commonly called a *south-easterly swell,*' may perhaps be better set down as *a swell from the S.E.*

The manner of reckoning the time at sea, has been described in a former part of this work, and the form of the Log Book generally used in the Merchant's service will be seen hereafter, we shall therefore proceed to explain the method of correcting the courses, and of working what is called a day's work at sea.

The correction of a ship's course at sea, for the variation of the compass, admits of the two following cases.

First.—*When the true course and variation of the compass are given, to find the compass course.*

RULE.—If the variation be *easterly,* allow it to the *left* of the course, but if *westerly* allow it to *right,* and the point or degree thus found, will be the compass course sought.

Example.—The true course from the ship to Cape Finisterre, being S. W. b. W. what is the course per compass; the variation being 2½ points W.?

Answer.—W. b. S. ½ W.

Examples for Exercise.

In which the compass courses are required.

True Courses.	Variation.	Compass Courses
N E b E	2 ½ pts. W	
S	1 ¼ „ E	
W b N	3 „ W	
W	2 ¾ „ W	
S S W ½ W	1 ½ „ E	
N 18° E	22° E	
S 25° W	34° W	

Second.—***The course steered by compass, and the variation of the compass, given, to find the true course.***

Rule.—If the variation be *easterly* allow it to the *right*, but if *westerly* allow it to the *left* of the compass course, the result will be the true course required.

Example.—Required the true course steered by a ship, whose compass course was N.E. b. E. ½ E. the variation being 1¼ W.

Answer.—N.E. ¼ E.

Examples for Exercise.

In which the true courses are required.

Compass Courses.	Variation.	True Courses.
S W b S ½ W	2 ½ E	
W S W ¾ W	3 ¼ W	
E	2 ¾ E	
N N E	1 ½ W	
E N E	2 ¼ W	
S 45° E	34° E	
N 64° W	26° W	

From the very nature of lee-way, as already explained, it is obvious that it must always be allowed *from the wind,* that is, to the right hand of the course steered, where the ship is on the larboard tack, and to the left hand when she is on the starboard tack.

Example.—Suppose a ship close-hauled, sails W. b. S. with the wind S. b. W. and makes 1 point lee-way, which tack is she on, and what is her true course?

Answer.—The ship is on the larboard tack, and her true course is W.

Examples for Exercise.

In which the courses steered with the lee-way and variation, to be allowed on each course, are given to find the true courses.

Compass Courses.	Winds.	Lee Way.	Variation.	True Courses.
W b N	S W b S	½	2 ¼ W	
W S W	S	1	1 ½ E	
S b W	W b S	2 ¼	3 W	
E b N	N b E	1 ½	2 ¾ W	
W	N N W	2	1 E	
N W b N	W b S	½	2 ½ W	

A very easy method of finding the ship's true course at noon is as follows:

Let the observer place himself in the same plane with the masts, and watch the sun coming to the meridian. Then take the angular distance between the masts and the sun, which will be the true course the ship is on at that time.

The computations to determine the ship's place at noon, from the several courses (corrected as above) and their corresponding distances run since the preceding noon, constitute what is called *a day's work;* and the latitude and longitude of the ship, deduced from thence, are called the latitude and longitude by *account,* or *dead reckoning,* in order to distinguish them from the latitude and longitude by lunar observation, or chronometers.

General directions for working a day's work.

Having prepared a table similar to that used in Traverse Sailing, enter therein the several courses steered, corrected for variation and lee-way (if any) and against each course place the whole distance run by the ship while she continued on that course, observing that in making out the first day's work after leaving the land, particular care is to be taken in putting down the bearing and distance of the departure (as a first course and distance) in the traverse table, to make use of the *opposite point of the compass to that bearing,* and also to make the proper correction for the variation. Find the difference of latitude and departure answering to each corrected course and distance, and put them down in their respective columns, and from them find the difference of latitude and departure made good upon the days run, as in traverse sailing, with this difference of latitude and departure; the true course and distance made good are to be found by inspection in the usual manner.

When the variation of the compass is given in degrees, it will be more convenient first to correct the courses for lee-way only, and with these courses and their respective distances, to find the difference of latitude and departure, and thence the *compass course* and the distance made good during the whole day's run. This course being then corrected for variation will give the *true course,* with which, and the distance already found, the *true* difference of latitude and departure may be readily obtained, and thence the true course and distance as before.

Having the difference of latitude, the latitude the ship is in, is to be found by the rule given in page 53, and the difference of longitude by Middle Latitude or Mercator's sailing, or by both, and the longitude in, by rule, page 54.

Having thus found the latitude and longitude the ship is in, her place may be pricked off on the chart, and the bearing and distance of the intended port, or of any place whose latitude and longitude are known, may be found by Case 1 of Mercator's or Middle Latitude sailing, for which purpose the method by inspection only need be employed.

The bearing thus found will be the *true* bearing, if, therefore, the *compass bearing* be required, the variation must be allowed according to the rule already given.

The setting of currents are to be corrected for variation only, and entered as courses in the Traverse Table, the drift being taken as a distance.

When a ship is lying-to the middle point between those on which she comes up and falls off, is to be taken for her apparent course, upon which the lee-way and variation are to be allowed to find the *true* course.

The following specimen of the Log book or Journal, will, it is presumed, be found sufficient to enable the student to make the proper correction on the different courses, and fully to understand the method of keeping the Journal of a ship at sea.

In the subjoined day's works the log is supposed to be hove every hour, and the knot divided into eight fathoms of six feet each.

EXTRACT

FROM A

JOURNAL

OF

A Voyage from England to Madeira,

IN THE SHIP

QUEEN;

J. T. COMMANDER,

KEPT BY

G. T. MATE,

1852

34

Ship QUEEN, from ENGLAND towards MADEIRA.

H.	K.	F.	Courses.	Winds.	Lee Way	Remarks, Monday, Feb. 6, 1852.
1			W.	E.S.E.		P.M.
2						At 2½ discharged the Pilot, James Smith, outside the Needles.
3						
4						Set studding sails.
5						
6						At 6, the Needles bore E.N.E. distant 14 miles. Durlestone Head, bearing N.W. ½ W. from the former of which I take my departure
7	6					
8	6					
9	6					
10	6					
11	6					
12	6					Midnight, moderate and hazy.
1	6					
2	6					
3	6					
4	6					Do. weather.
5	6					
6	6					Washed decks
7	6					
8	7					
9	7					Took a pull on the halyards and sheets fore and aft. and set all the sails fair.
10	7					
11	7					
12	6					Noon moderate and hazy, Var. 2¾pts. W.

Course	Dist.	Diff Lat.	Dep.	Lat. by Acc.	Lat. by Obs.	Diff. Long.	Long. by Acc.	Long. by Obs.	Bearing and Distance.
S. 62°W.	125′	58′ S.	110·6′ W	49° 42′ N.		173′ W.	4° 27′ W.		

H.	K.	F.	Courses	Winds.	Lee Way	Remarks, Tuesday, Feb. 7, 1852.
1	7	4	W. b S. ¼ S	S.E.		P.M. moderate and cloudy.
2	7	4				All sail set to the best advantage.
3	6	4				
4	6	4				Hands employed clearing away, as requisite, and lacing on mats, &c.
5	6	4				
6	6					
7	6					
8	6					Long. by chron. at 8h 30m 6° 59′ 45″W.
9	6					
10	6					
11	6					
12	6					Midnight. Fresh breezes.
1	7	4				
2	7	4				
3	6	4				
4	6	4				Spoke a barque bound to Rio Janeiro.
5	6	4				
6	6					Washed decks.
7	6	4				
8	6	4				Pumps attended to every 4 hours.
9	7	4				Long. by chr. at 8h 30m brought on by log to noon, places the ship in long. 7°24′45″W.
10	7	4				
11	7	4				lat. by mer. alt. ⊙l.l. 48°N.
12	7	4				Noon fresh breezes. Var. 2¼pts.W.

Course.	Dist.	Diff. Lat.	Dep.	Lat. by Acc.	Lat. by Obs.	Diff. Long	Long. by Acc.	Long. by Obs.	Bearing and Distances.
S.W ¼W.	160′	101·5′ S.	123·7′ W.	48° N.	48° N.	188·6′	7° 36′ W.	7° 25° W.	

Traverse Table.

True courses.	Dist·	N.	S.	E.	W.
S. W. b S. ¾ W.	14		10·4		9·4
S. W. b W. ¾ W.	112		47.9		101·2
		diff. lat.	58·3	Dep.	110·6

To find the Course and distance made good.

Diff. Lat......58·3m. } by Table 2. { Cou S· 62°W. or S.W.b.W.½W.
Dep.........110·6m } { Dist....................125m.

To find the latitude in. &c.

Lat. of the Needles........... 50° 40′N.
Diff. Lat................... — 58 S.

Lat. in by account........... 49 42 N.
Sum of lats. 100 22
Mid. lat..................... 50 11
Co. mid. lat. 39 49

Then,

Co. mid. lat...... 39¾° } by Table 2. { Diff. long 173m
Dep............ 110·6m. }

To find the long. in,

Long. of the Needles. .... 1° 34′W.
Diff. long, 173m. ... . = 2 53 W.

Long. in......................... 4 27 W.

To find the diff. lat. and dep,

True cou. S.W. ½ W..... = 4½pts. } by Table 1. { Diff. lat S...........101·5m.
Dist.................. 160m. } { Dep. W .... 123·7m.

To find the latitude in, &c.

Yesterday's lat............. 49° 42′N· Mer. pts........ 3447
Diff. lat. 101·5m......... = 1 42 S.

Lat in by acc............. 48 0 N. Mer. pts........ 3292

Sum of lats. .... 97 42 Mer. diff. lat..... .155
Mid. lat................. 48 51

Co. mid. lat. .... 41 9 } by Table 2 { Diff. long..... 188·5m.
Dep. .... 123·7 }

Course S.W. ½ W........ = 4½ pts. } by Table 1. { Diff. long. .... 188·6m.
Mer. diff. lat. .... 155 }

To find the long. in

Yesterday's long. .... 4° 27′W.
Diff. long. 188·6m................ = 3 9 W.

Long. in by acc. .... 7 36 W.

Ship Queen, from England towards Madeira.

H.	K.	F	Courses.	Winds.	Lee way.	Remarks, Wednesday, Feb. 8, 1852.
1	6	4	W.S.W.	S.E.		P.M.
2	6	3				In studding sails.
3	6			S.S.E.		
4	6	1				
5	4	4	S.W.b.W.	S.b.E.	½	Fresh breezes and cloudy weather. In top-gallant sails.
6	4	2				
7	4	2				
8	4				½	In first reef top sails.
9	4					Unbent the cables and stowed the anchors.
10	4	6				
11	4	4				
12	4	4				Midnight. Breeze increasing
1	4	2				
2	4	2				
3	4					
4	4					
5	4					
6	4	2				
7	4	4				Strong breezes and cloudy
8	4		W.S.W.	S.	1	In second reef top sails.
9	3	4			2	Stowed the jib
10	3	4				Close reefed top sails and sent down top-gallant yards.
11	3	4				
12	3	4				Noon. cloudy. Sun obscure. Var.2½pts.W.

Course.	Dist	Diff. Lat	Dep	Lat. by Acc.	Lat. by Obs.	Diff. Long.	Long. by Acc.	Long. by Obs.	Bearings and Distance.
S. 39° W.	105′	82′ S.	66·3′ W.	46° 38′ N.		98·2′ W.	9° 3′ W.		

H.	K.	F.	Courses.	Winds.	Lee way	Remarks, Thursday, Feb. 9, 1852.
1	4	4	W.b.S.	S. b. W.	3	P.M. Fresh gales with squalls and showers of rain. Handed the main sail and mizen-top sail.
2	4	4				
3	3					
4			up W. S. W. off W.			Handed the fore-top sail, fore sail, and fore-top-mast stay-sail and brought the ship to, under a close reefed main-top-sail, and mizen stay-sail. At seven o'clock more moderate. Set fore sail, mizen and fore and mizen top sails close reefed, and fore-top mast stay-sail. Out two reefs of top sails. Sent top gallant yards up and set main-top-gallant sail over single reefed top-sail.
5					6	
6						
7	3		S. W. b. W.	S. b. E.	3	
8	3					
9	3					
10	4					
11	4					
12	5					
1	5	2				Midnight. Moderate and cloudy.
2	5					
3	4	6				
4	4	6	W. S. W.	S.	1	Fair weather: Out all reefs of top sails
5	4	4				Set the fore and mizen top-gallant sails
6	4					
7	5					
8	5	2				Variation by an azimuth 22°W.
9	5	4				
10	5					
11	5					Noon. Lat. by mer. alt. sun's l. l. 46°N.
12	5					

Course.	Dist	Diff Lat	Dep	Lat by Acc	Lat. by Obs.	Di . Long.	Long. by Acc.	Long. by Obs.	Bearing and distance.
S67°W.	93′	36·3′ S	85·6′ W.	46° 2′ N	46° N.	125·2′ W.	11° 8′ W.		

Traverse Table.

True Courses.	Dist.	N.	S.	E.	W.
S. W. b. S. ½W.	25		19·3		15·9
S. S. W. ¾W.	13		11·2		6·7
S. W. b. S.	51		42·4		28·3
S. W. ½W.	4		2·5		3·1
S. W. b. W. ½W.	14		6·6		12·3
		Diff. lat.	82·0	Dep.	66·3

To find the Course and Distance made good.

Diff. lat................ 82m. } by Table 2. { Cou. S. 39°S. W. b. S. ½W.
Dep. ....66·3m. } { Dist............ 105m.

To find the latitude in, &c.

Yesterday's lat.............. 48° 0′N. Mer. pts. 3292
Diff. lat. 82m .... = 1 22 S.

Lat. in by account......... 46 38 N, Mer. pts........... 3171

Sum of lats.............. 94 38 Mer. diff. lat ...... ·121
Mid. lat................. 47 19
Co. mid. lat...... .... 42 41 } by Table 2. { Diff. long. 98m.
Dep..................... 66 3m. }
Cou.................... S. 39° W. } by Table 2. { Diff. long. 98·2m.
Mer. diff. lat. .... 121 m. }

To find the Longitude in.

Yesterday's long. by obs.... 7° 25′W
Diff. long. 98·2m. ..... = 1 38 W.

Long. in by acc........... 9 3 W.

Traverse Table.

Mag. courses.	Dist.	N.	S.	E.	W.
W. N. W.	12	4·6			11·1
N. W. b. N.	3	2·5			1·7
W.	37				37·0
W. b. S.	44		8·6		43·2
		7·1	8·6 7·1	Dep.	93·0
	Diff. lat.		1·5		

The middle point between those to which the ship, when lying-to, comes up and falls off, corrected for lee-way, together with drift (estimated at 3 knots for the three hours,) are entered as the second magnetic course and distance in the Traverse Table.

Diff. lat. .. 1·5m. } by T. 2. { Mag. cou... S. 89°W. Mag. course.... S. 89° W.
Dep. ..... 93m. } { Dist........ 93m. Var. by azimuth 22 W.

True course.... S. 67 W.

True co .. S. 67 W. } by T 2. { True diff. lat...... 36·3
Distance. 93m. } { True dep......... 85·6
Yesterday's lat. by acc....... 46° 38′N. Mer pts........ 3171
Diff. lat. .... 0 36 S.

Lat. in by acc............. 46 2 N. Mer. pts. 3118

Sum of lats............... 92 40 Mer diff. lat..... 53
Mid. lat.................. 46 20
Co. mid. lat.............. 43 40 } Diff. long 124·5m.
Dep...................... 85·6m. }
Course .... 67° } Diff. long. ..... 125·2=2° 5′W.
Mer. diff. lat............ 53m. }
Yesterday's long. by acc. .... 9 3 W.
Long. in by acc... 11 8 W.

Ship QUEEN, from ENGLAND towards MADEIRA.

H.	K.	F.	Courses.	Winds.	Lee way	Remarks, Friday, Feb, 10, 1852.
1	5		W.b.S.	S.bW.	½	P.M. Moderate and clear weather.
2	5	2				
3	5	2				
4	5	4				{ Tacked ship to the S.E and trimmed the sails by the wind.
5	5	2	S.E.b.S.	S.W.b.S	¼	
6	5					
7	5					
8	4	6				Set the royals and flying jib.
9	4	4				
10	4	4				
11	4	2	S.b.E.	S.W. b.W.		
12	4	4				Midnight. Moderate and cloudy.
1	5					
2	5					
3	4	2				
4	4					
5	4					
6	4		S.b.W.	W.b.S.		
7	2	6				Light winds and variable. All sail set.
8	3					
9	2					{ Took a pull on the halyards and sheets fore and aft, and set all sail fair.
10	2					
11	2	2				
12	3					Noon lat. by obs. ⊙ 44° 51′ Var. 22°

Course	Dist.	Diff. Lat.	Dep.	Lat. by acc.	Lat. by Obs.	Diff. Long.	Long. by Acc.	Long. by Obs	Bearing and Distance.
S.21E.	74′	69′ ·1S	26′·5E	44° 51′	44°51′ N.	38′ E.	10° 30′W		

H.	K.	F.	Courses.	Winds.	Lee way.	Remarks, Saturday, Feb. 11, 1852,
1	2		S.b.W.	W b.N.		P.M. Light airs and fine weather.
2	2					People employed variously. Sailmaker about the trysail.
3	2					
4	2	4				
5	2	4				Pleasant breezes and clear weather.
6	2	6		N.W b.W.		Saw a strange sail ahead standing to the northward, on the larboard tack.
7	3					
8	3					At 9, P.M. spoke the stranger, which proved to be the brig Jane, of London, Jones, Master, from Teneriffe, out 6 days, bound to Liverpool.
9	2	6				
10	3					
11	3	2				
12	3	2				Midnight. Moderate and clear.
1	4		S.S.W.			
2	4					
3	4					An increasing breeze with a heavy swell from west, for which I allow 6 miles.
4	5					
5	5	4		N.W.b.N.		
6	5	4				
7	5		S.W. ¼ W.			Steady breeze and fine clear weather.
8	4	6				
9	4	6				Long. by chro. at 11h, 40m. brought on by log. to noon 10° 40′ W.
10	4	4				
11	5					Latitude by double altitudes 43° 30′N.
12	5					Noon moderate and clear Var 2 pts W.

Course.	Dist.	Diff. Lat.	Dep.	Lat. by Acc.	Lat. by Obs	Diff, Long.	Long. by Acc.	Long. by Obs.	Bearing and Distance,
S. 2° W.	83′	82·7′ S.	3′ W.	43° 28′ N.	43° 30′ N.	4′ W.	10° 34′ W.	10° 40′ W.	

Examples for Exercise.

H.	K.	F.	Courses.	Winds.	Lee way.	Remarks.
1						
2	6		W. by N.	S. S.W.	¼	I take my departure from a point in lat. 52° 42′S. long 74° 44′W. bearing E.N.E. distant 21 miles.
3	6	4				
4	7					
5	6	6			0	
6	5					
7	5	4				
8	5	6				
9	6		N.W.	S.W-b.W.	½	
10	6	4				
11	6	6				
12	7				¾	
1	8					Tacked
2	7		South.	W.S.W.	¼	
3	6					
4	5					
5	4					A current sets N E. by N. 28 miles in 24 hours.
6	4		S.E,		0	
7	4	4				
8	4	6				
9	5					
10	6			S.S.W.	¼	Variation 1¾ pts. E.
11	7	4				
12	7	6				

Course.	Dist.	Diff. Lat.	Dep.	Lat. by Acc.	Lat. by Obs	Diff. Long.	Long. by Acc.	Long. by Obs.	Bearing and Distance.
N66°½ W	36·2 m.	14·7′	33·4′	52° 27′ S.		56′	75° 40′ W.		

H.	K.	F.	Courses.	Winds,	Lee way.	Remarks.
1						I take my departure from a point in lat. 52° 34′S. long. 169° 9′E. bearing N.E. by N. distance 17 miles.
2	7		E.S.E.	N.W.	0	
3	7	4				
4	7	6				
5	8					
6	7	6		W.S.W.	0	
7	7	4				
8	7			S.	¼	
9	7					
10	6	8	East.	S.S.E.	½	
11	6	2				
12	7					
1	8		N.N.E.		0	
2	8	4				
3	8	4				
4	7	6				A current sets N. at the rate of 11 miles per day.
5	7	6				
6	8		N.W. by W.		0	
7	7					
8	6					
9	6	4				
10	6	6				
11	5	6				Variation 1½ pts E.
12	5	4				

Course.	Dist.	Diff. Lat.	Dep.	Lat. by Acc.	Lat. by Obs	Diff. Long.	Long. by Acc.	Long by Obs.	Bearing and Distance.
N. 65° E.	58	24·7′	52·6′	52° 9′S.		86′	170° 35′ E.		

EXPLANATION

OF

THE TABLES.

TABLES 1 AND 2.

Traverse Tables.

THESE Tables derive their name from their great use in Traverse sailing, or in reducing compound courses to single ones, and as they contain the several parts of right-angled plane triangles, they afford an easy and expeditious method of solving all problems, in which right-angled plane triangles are concerned, where very great accuracy is not required.

The angles in Table 1, are given to every quarter point of the compass, and those in Table 2 to every degree of the quadrant, the sides of the triangle in both tables being nautically expressed, although it is obvious, that the tables themselves, are equally applicable to the general purposes of right-angled plane Trigonometry.

The degree and minute corresponding to each point, are inserted in Table 1, and the time to each degree in Table 2.

When the course is less than 4 points or 45° the Tables are to be entered from the top, but at the bottom, when it exceeds 4 points or 45°.

When the course and one of the sides are given, the other sides will be found even with it, in the same horizontal line; when two sides are given to find the angle of course and the remaining side, the two given sides are to be sought for, till they are found as nearly as possible together in one of the pages of Table 2, and the course is to be taken from the top or bottom of the same page, according as the names of the given sides are found to agree at the head or foot of the page. It is also to be observed that when the difference of latitude and departure are given, to find the course and distance, if the difference of latitude exceed the departure, the course will be less than 45° but above 45° if the departure be greater than the difference of latitude.

When any given side exceeds the limits of the table, such an aliquot part must be taken, as may reduce it within those limits; and should two sides be given, they must both be divided by the same number, observing, that whenever this is done, the corresponding side or sides taken out of the table, must be multiplied by the same figure, that the given number is divided by;—the angles must in no case be multiplied or divided.

When the given distance exceeds 300 miles, it may sometimes be found more convenient to take out the differense of latitude and departure for 300, and then for the excess above 300, which results being added together will give the true answer. For illustrations of the use of these tables, see any of the worked examples in Plane sailing, and solved by inspection.

TABLE 3.

Logarithms of sines, tangents, &c. to every quarter point of the compass.

The use of this table is to find the logarithmic sine, tangent, &c. of a ship's course, when given in points and quarter points of the compass. When the ship's course does not exceed 4 points, it is to be found in the *left hand* side column of the table, and the logarithmic sine, tangent, &c. is to be sought for in the column so named at the top of the table; but when the course exceeds 4 points, it is to be found in the right-hand column, and the required sine, tangent, &c. in the column so named at the *bottom* of the table.

TABLE 4.

Logarithm of numbers.

The logarithm of a number consists of two parts, the *index* and the *decimal part*; the table contains both these parts for all the numbers from 1 to 100 inclusive, but for numbers above 100 the decimal part of the logarithm only is given in the table; the decimal throughout the whole table being carried out to six places of figures. As however, five places are sufficient for most calculations that occur in navigation, the sixth figure is generally omitted, but care must be taken in so doing, that if the sixth figure be a 5, or above a 5, the fifth figure is to be increased by 1* thus, the logarithm ·770606, taken out to five places of figures, will become ·77061. The index is easily supplied by observing that it is always less by 1, than the number of integers in the integral part of the given number. But if the number consist of decimals only, then add 1 to the number of ciphers before the first significant figure after the decimal point, and subtract this sum from 10, the remainder is the index. By this method the confusion that might arise from the use of negative indices is avoided. In nautical calculations however, instances requiring the application of a negative index, or its substitute, very rarely occur.

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[*] This remark applies to all the Logarithmic Tables, in which the decimals are carried out to six places, and will not therefore be repeated.

To find the logarithm of a natural number.

If the number consist of not more than two figures. Look for it in one of the columns marked No. in the first page of the table, opposite to which, in the columns marked Log. will be found the decimal part of the logarithm, together with the index, if the given number be wholly integral; but if it be partly or entirely decimal, the index is to be found according to directions, page 273, and prefixed to the decimals; thus, the logarithm of the number 52 is 1·71600, of 5·2, is 0·71600; and of ·52, is 9·71600, for there being no cipher before the ·5 add 1, then 1 subtracted from 10 leaves 9, the index.

If the number consist of three figures, whether integers or decimals, seek for them in the left hand column of the table, and even with them, in the adjoining column marked 0 at the top, will be found the decimal part of the logarithm, to which the index (found by the foregoing rules,) being prefixed, will give the whole logarithm sought. Thus, the logarithm of 476 is 2·67761, and the logarithm of 47·6 is 1·67761.

If the given number consist of four figures, the three first are to be found in the side column as above, and the fourth figure at the top, then in the column immediately under the fourth figure, and on the same horizontal line with the three first, will be found the decimal part of the logarithm, to which the proper index is to be applied as before, thus, the logarithm of 4576 is 3·66049.

To find the logarithm of a number, consisting of more than four figures, find the logarithm of the first four figures as before directed, then take out the number which stands opposite in the right hand column marked *diff.* at the top, and multiply this number by the figures above four, cut off from the product as many figures as the multiplier consists of, and add those which remain to the logarithm already taken out, the sum having the proper index prefixed, will be the whole logarithm required. Thus, to find the logarithm of 576524 the logarithm of 5765 is 760799, and the diff. 75 × 24 = 1800, cutting off the two last figures, leaves 18, which added to 760799, gives 760817, therefore 5·760817 or 5·76082 is the required logarithm.

To find the natural number corresponding to a given logarithm.

When the number is not wanted to consist of more than four places of figures. Find in the body of the table the decimal part of the given logarithm or the nearest to it. Take out the corresponding figures in the left side column, and annex to them, if required, the figure which stands at the head of the column wherein the decimal figures were found; then to place the decimal point add 1 to the given index of the log, and point off to the left this number of figures for whole numbers, the rest if any, will be decimals.

When the number is to consist of more than four places of figures. Take the difference between the given logarithm, and the next less in the table, to which annex as many ciphers as there are figures wanted above four, and divide by the corresponding number taken out of the column of differences, the quotient will consist of the figures, which being annexed to the number answering to the next less log, will give the number sought, by applying the decimal point as directed above; in addition to which directions it is to be observed, that if the number required is to be wholly decimal, nine ciphers, lessened by the value of the index, are to be prefixed to the number found. These rules being the reverse of those given for the *direct process*, may be illustrated by the same examples, by merely transposing the questions and answers.

The arithmetical complement to any Logarithm,

May be found by beginning at the left hand, and subtracting each figure successively from 9, except the last significant figure on the right, which is to be taken from 10, but should the index exceed 9 it is to be taken from 19,—This rule applies to the logarithms of sines, tangents, and secants, as well as to the logarithms of numbers.

TABLE 5.

Logarithms of Sines, Tangents, and Secants.

This table contains what are commonly called, the artificial sines, tangents, and secants, to each degree and minute of the quadrant, with their complements or co-sines, co-tangents, and co-secants, the integral and the decimal parts of the logarithms, being both expressed in the table; the second column and last but one in the several pages of which, contain a time scale adapted to each minute of arc. This table, therefore, is very convenient for turning arc into time and the converse, but its principal utility consists in the facilities it offers for entering the table with the time direct, and thus, in many instances, saving the trouble of a double transmutation.

The sines and tangents in this table are employed in the method of determining the longitude by lunar observations; it is only necessary to take the logs to four places, increasing the fourth figure 1, if the fifth is 5, or above 5.

To find the Logarithmic sine, co-sine, &c. of any arc or angle, in degrees and minutes.

If the degrees be under 45, they are to be taken from the top, and the minutes (if any,) from the *left* side column; the name of the required logarithm as sine, tangent, &c. is also to be sought at the top of its column, immediately under which, and even with the given minutes, will be found the logarithm required. If the given degrees exceed 45, they are to be found at the bottom; the minutes in the *right* side column, and the title of the logarithm is to be taken from the foot of the column. Thus, the log sine of 10° 15′ is 9·25028 the log. tangent of 65° 20′ is 10·33796: when the given degrees, &c. exceed 90° find the logarithmic sine, &c. for the supplement to 180°, or, which will be generally easier, if the *sine* be required, find the logarithmic co-sine for the excess of the given arc or angle above 90°; if the tangent to the arc or angle be required, find the co-tangent of the excess above 90°, and so on.

Thus, the logarithmic sine of 140° 10′ is the logarithmic sine of 39° 50′, or the logarithmic co-sine of 50° 10′. &c,

To find the logarithmic sine, &c. to seconds. Having found the logarithmic sine, &c. answering to the given degrees and minutes as above, take out from the proper column marked at the top Diff. or D. the difference of the adjacent logs. to 100 seconds; multiply this difference by the given seconds, and reject two figures from the right of the product, then those remaining being added to the log. sine, tangent, or secant, of the given degrees and minutes, or subtracted from the log. co-sine, co-tangent, or co-secant, will give the logarithm sought. It must however be carefully noted, that the differences to the sines, and co-sines, are set down, the former to the right, and the latter to the left, of their respective columns; the differences to the tangents and co-tangents are the same, and are therefore placed between them, and the differences to the secants and co-secants, being the same as those to the co-sines and sines, are to be found in the columns corresponding to the latter.

Thus to find the logarithmic sine of 24° 10′ 15″, the logarithmic sine of 24° 10′ is 9·612140, and the difference 469, which last multiplied by 15, the given number of seconds, and two figures rejected from the right of the product is 70, therefore 9·612140 + 70 = 9·612210, the logarithm required.

When the logarithmic sine, tangent, &c. is given to find the corresponding arc, we have only to reverse the operations already described in explaining the use of this table; to do which, find the next less logarithm, to the given one, if it be a sine, tangent or secant, or the next greater, if it be a co-sine, co-tangent, or co-secant, and take out the corresponding degrees and minutes, then take the difference between the logarithm thus found, and the given one, to which add two ciphers, and divide that number by the difference of 100″, the quotient will be the seconds to be annexed to the degrees and minutes already found.

The logarithmic sines and tangents varying by very considerable differences near the beginning and end of the quadrant, are given, for the sake of accuracy, with their differences for the first and second degrees to every 10 seconds; the terms are also the co-sines and co-tangents of the last two degrees of the quadrant; this part of the table however, being seldom or never used in the ordinary calculations in navigation, renders any farther description of it unnecessary.

TABLE 6.

Meridional Parts.

This table shews the number of minutes contained in each degree of latitude to 80° on mercator's chart. The parts are to be found corresponding to the degree at the top or bottom, and the minute in one of the side columns. Thus the meridional parts corresponding to the latitude 52° 10′ are 3681.

TABLE 7.

Refraction in Altitude.

It has been before explained, in page 154, that the density of the atmosphere increases in proportion to its proximity to the surface of the earth, and therefore causes the rays from a celestial object, to form a curve in passing to the horizon. This table is adapted to a mean state of the atmosphere, that is, when the barometer stands at 29·6 and the thermometer at 50°, and the correction, which is *always subtractive,* is found opposite to the given altitude; thus, the mean refraction at the apparent altitude of 6° 55′ is 7′ 25″.

The refraction at any *altitude,* may, however, be simply computed as follows, sufficiently correct, not only for Nautical, but even for Astronomical purposes, at altitudes not less than 10°. The refractions at different altitudes, are *very nearly* as the *co-tangents of the altitudes,* or, as *the tangents of the zenith distances.*

Tangent of 45° = 10·00000, and the refraction at 45° = 57″, for barometer 29·6, and thermometer 50; or 58″ for barometer 30, and thermometer 50.

Now suppose apparent altitude 20°.

$$\begin{array}{lll}
57'' \text{ log.} \ldots\ldots & = & 1{\cdot}75587 \\
20^\circ \text{ cotang.} \ldots\ldots & = & \underline{10{\cdot}43893} \\
 & & 2{\cdot}19480 = \left.\begin{array}{l}\underline{156{\cdot}60''} \\ 2'36''\ 6\end{array}\right\} \text{ mean refraction.} \\
\text{or, } 58'' \text{ log.} \ldots & = & 1{\cdot}76343 \\
\quad 20^\circ \text{ cotang.} & = & \underline{10{\cdot}43893} \\
 & & 2{\cdot}20236 = 159{\cdot}35'' = 2'\ 39{\cdot}4'' \text{ true refraction.}
\end{array}$$

At *high* altitudes these results will be extremely near those deduced from the best and most rigid formula. At all altitudes between 70° and 90°, the refraction will be, at *mean temperature,* about 1″ for every degree of zenith distance; and at 90° both refraction and parallax vanish.

TABLE 8.

Dip of the Marine Horizon.

The depression, or dip of the horizon, is the angle contained between a horizontal line passing through the eye of an observer, and a line joining the eye with the visible horizon, see page 149. This table contains a correction to be subtracted from the observed altitude of a celestial object; thus, the height of the eye being 22 feet, the correction, or dip is 4′ 30″; this correction may be approximately computed as follows:

The square root of the height of the eye in feet, will give the dip *approximately in minutes,* from which subtract 1″ for every minute thus found; and the remainder will give the *dip,* sufficiently correct for any calculations, whilst the height of the eye does not exceed 100 feet; for example:—

Suppose the dip is required for 16 feet.

√ 16 = 4′ 0″ for 25 feet.. √ 25 = 5′ 0″
sub .... 4 sub.... 5
true dip. 3 56 4 55 true dip
for 30·25 ft. √ 30·25 = 5′ 30″
sub. ...... 5·5
5 24·5 true dip.

TABLE 9.

Dip of the Marine Horizon, at different distances.

When the horizon immediately under the celestial object is obstructed by land, and the observer within five or six miles of the shore, then if the object be brought down to the line separating the sea and land, the dip will be increased with the proximity of the land: the dip is then to be taken from this table, instead of Table 8, the height of the eye is here to be found at the top, and the distance (in miles) in the side column; thus, if the edge of the sea be 3 miles distant, and the height of the eye 15 feet, the correction will be 4′.

TABLE 10.

The Sun's parallax in Altitude.

The difference between the places of the sun, as seen from the surface and the centre of the earth, at the same instant, is called his parallax in altitude, and is always *additive* to the sun's altitude opposite to which it is found. It may be computed as follows:

To the co-sine of the sun's apparent altitude, add the constant logarithm of the sun's mean hor. par. 0·945124 = 8·81″, the sum, rejecting 10 from the index, will be the logarithm of the parallax in altitude.

Suppose the sun's app alt..... 30° 20′ cos. 9·936062
constant log.............................. 0·945124
7·606″ log................ 0·881186

TABLE 11.

Correction of the mean refraction.

As it has been before observed in Table 7, that the refraction of the heavenly bodies depends on the density of the atmosphere, and this more particularly when the altitude is low, the refraction in Table 7 (being adapted to a mean state of the atmosphere,) must be corrected by the seconds in this table for the variation in the weight and temperature of the air, indicated by the heights in the barometer and thermometer The correction is to be taken out with the apparent altitude in the side column, the height of the thermometer at the top, and that of the barometer at the bottom, and to be applied by addition or subtraction, according as the sign + or — is found at the head of the column, from which the correction is taken.

TABLE 12.

The right ascension and declination of the principal fixed stars.

This table contains the mean right ascensions, and declinations of 61 principal stars, for the 1st January 1840, with their annual variations, in seconds and decimal parts of seconds; the mean places may be found for any time subsequent to the year 1840, by multiplying the annual variation both in right ascension and declination, by the number of years and parts of a year elapsed since that time, observing that the product for the right ascension is always to be added to that given in the table, but the correction for the declination is additive or subtractive, according as the sign + or — is prefixed to the annual variation. The corrections thus applied to the ascension and declination for the year 1840, will give the mean place of the star at the time required.

To find the place of a star for any time prior to 1840, the correction must be applied with the contrary signs.

When great accuracy is required, it will be desirable to take the declination and right ascension of the stars from the N. A. pages 444 to 476.

TABLE 13.

Correction for the Sun's apparent altitude.

This table contains the sun's refraction in altitude, diminished by parallax, being a correction to be applied by subtraction, to the apparent altitude of the sun, in order to obtain the true altitude. It is also used in clearing distances from the effect of refraction and parallax; thus the correction answering to the apparent altitude 25° 40′ is 1′ 50″.

TABLE 14.

Correction for the observed altitude of the sun's lower limb.

This table affords an expeditious method for correcting the meridian altitude of the sun's lower limb, for the joint effect of semidiameter, dip, refraction, and parallax. In the calculation of this table, the sun's semidiameter is assumed at 16′, and its variation from that quantity in each month in the year, as given at the foot of the page, is to be added to, or subtracted from the correction found in the table, (which is always additive,) according as the sign + or — is prefixed to it.

The table is to be entered with the sun's observed altitude in the left side column, and the height of the eye at the top; thus, suppose the sun's observed altitude in the month of June to be 11° 30′ 15″, and the height of the eye 16 feet, its true altitude may be found as follows,

Obs. alt. ☉'s lower limb....................		11°	30′	15″
Cor to alt. 11° 30′ and height of 16 feet 7′ 36″ Do. for variation of sun's semid. in June. — 12	+		7	24
true alt of sun's centre		11	37	39

TABLE 15.

For reducing longitude into time, and the contrary.

By means of this table, longitude may be converted into time, or time into longitude, by inspection only, in the following manner.

Suppose it were required to find the time, answering to 67° 12′ 56″ of longitude.

	°	′	″		h	m	s	th
Time answering to..........	67	0	0	is	4	28	0	0
do. to..........	0	12	0	is	0	0	48	0
do. to..........	0	0	56	is	0	0	3	44
hence the time answering to..	67	12	56	is	4	28	51	44

Suppose the degrees &c. of longitude answering to 6ʰ 31ᵐ 12ˢ be required.

	h	m	s		°	′	″
Longitude answering to..............	6	28	0	is	97	0	0
do. to.............	0	3	12	is	0	48	0
hence the long. corresponding to......	6	31	12	is	97	48	0

Rules for converting time into longitude, and the contrary, without referring to this table, will be found in pages 159 of the present work.

TABLE 16.

Sun's declination to 1859.

This table contains the declination of the sun for each day of the year, at noon, to the above period, for the meridian of Greenwich, and will answer for any subsequent year till 1866, by applying the corrections from Table [illegible].

TABLE 17.

To correct the Sun's declination at noon, for longitude.

The table is entered with the declination at the top, and the nearest longitude in the side columns; the correction to be added or subtracted according to the directions at the head of the table.

TABLE 18.

To correct the Sun's declination for periods of four years.

This table is to be entered with the period of years in either of the side columns, and the month and nearest day at the top, the corresponding minutes of correction, are to be applied to the declination, taken from Table 16, answering to the number of whole periods of four years each, antecedent to that of the given year, by addition or subtraction as may be directed at the head of the column. Thus, suppose it be required to find the sun's declination, for the meridian of Greenwich at noon, on Feb. 28, 1854, this being eight years or two periods of four years each after 1846, the sun's declination for the given day of the month in the year 1846, is to be taken out of Table 16, where it is found to be 7° 59′S. then in Table 18, under the month of Feb. the 28th day, and even with 8 in the side column, (containing the periods of four years,) will be found the correction 1′ having over it at the top of the column, *sub*; therefore 7° 59′—1′=7° 58′ the sun's declination for the required day and year.

TABLE 19.

Semidiurnal and Seminocturnal Arches.

This table shews half the time, that a celestial object continues above the horizon, when the declination and latitude are of the same name, or below it when they are of contrary names, whence, the apparent time of its rising and setting, may be obtained. The table is to be entered with the latitude, in either of the side columns and the declination at the top, in the angle of meeting, will be found the arc required, which, if the object be the sun, will be the apparent time of its setting, when the latitude and declination are of the same name, and of its rising, when they are of contrary names; this subtracted from 12h. will give the apparent time of the sun's rising in the former case, and of its setting in the latter; double the time of his rising will be the length of the night, and double the time of his setting, the length of the day.

The semidiurnal arch expresses the time that a celestial object takes in ascending from the eastern horizon to the meridian; or, of its descending from the meridian to the western horizon.

Example.—Suppose in latitude 38° 30′N. when the sun's declination is 15°N. it be required to find the apparent time of the sun's rising and setting, with the length of the day and night.

	h	m
Under dec. 15° and taking half way between lat. 38° and 39° we get for the app. time of sun setting ...	6	49
which taken from............................	12	
Gives app. time of the sun's rising	5	11
then 6h 49m × 2 gives for the length of the day	13	38
and 5h 11m. × 2 gives for the length of the night ...	10	22

To find the apparent time of a star's rising and setting.

Subtract the sun's right ascension from the star's right ascension, (increased if necessary by 24h.) the remainder is the approximate time of the star's passing the meridian.* Then with the latitude and declination, find in the table, the time the star takes in ascending from the horizon to the meridian, and descending from the meridian to the horizon, when the latitude and the declination are of the same name. Subtracting therefore these hours and minutes, from the time of its meridional passage, the remainder will be the apparent time of its rising, or adding them to it, the sum will be the time of its setting.

But if the latitude and declination be of contrary names, the time thus found, will be half the period of the stars continuance below the horizon, and subtracted from 12h. will give half the time of its remaining above the horizon, with which proceed as above.

To obtain the mean time of the sun or a star's rising or setting, the equation of time, taken from the Nautical Almanac, must be applied to the apparent time found as above.

The mean time of the rising and setting of the planets, may be computed in a similar manner, observing to take out their declination and meridional passage from pages 251 to 431, of the Nautical Almanac for 1852.

To find the time of the rising and setting of the Moon.

The mean time of her meridional passage at Greenwich, must be taken from page IV of the month in the Nautical Almanac, and a correction applied from Table 21, to obtain the time of its meridian passage at the given place. Then with the moon's declination at the time of its passing the meridian, N.A. p. V. to XII. and the latitude of the place, find the semidiurnal arc as before, which subtracted from the above reduced time, will give the approximate time of the moon's rising, or added thereto, will give that of its setting.

If however, very great accuracy be required, the declination must be taken from the Nautical Almanac, corresponding to the approximate time of its rising or setting, reduced to Greenwich time; then the semidiurnal arc being again found and corrected, by adding the minutes from Table 21, corresponding thereto, and the daily variation of her meridional passage, the sum subtracted from, or added to the reduced passage over the meridian, will give the mean time of her rising or setting very near the truth.

TABLE 20.

The time of the meridional passages of the principal Fixed Stars.

This table shews the apparent time of the principal stars passing the meridian, on the 1st day of each month; the time of their transit on any intermediate day, may be found by multiplying the number of days since the 1st of the month by 4, and subtracting the result from the time of the transit on that day. Observing that the results thus obtained (being only approximations,) may differ a few minutes from the truth, but will be found sufficiently exact for the purposes they are designed to answer.

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* For the time of the principal stars passing the meridian, see Table 20.

TABLE 21.

For reducing the time of the Moon's passage over the meridian of Greenwich, to the time of her passage over any other meridian.

The daily variation of the moon's meridional passage, is the difference between the time of the transit on a given day and the day preceding, if the longitude be E. or the day following if it be W. and is to be taken from page IV of the month, in the Nautical Almanac.

The table is to be entered with the daily variation at the top, and the longitude, to the nearest minute, in the left side column, the correction being additive to the time of meridian passage in W. longitude, and subtractive in E.

TABLE 22.

Moon's Augmentation

Since it is the property of an object to increase its apparent diameter in proportion to the rate in which its distance from the eye of an observer is diminished, and, since the moon is nearer to an observer on the earth, when she is in the zenith, than when in the horizon, by the earth's semidiameter; she must therefore increase her semidiameter by a certain quantity, as she increases her altitude, this increase is called her augmentation.

The correction given in this table therefore, consists of a certain number of seconds, (called the moon's augmentation,) by which the moon's apparent horizontal semidiameter, is to be increased in order to obtain her true apparent semidiameter at any assigned altitude; the table being entered with the moon's apparent altitude at the top, immediately under which will be found the correction.

Since all parts of the horizontal semidiameter of the sun or moon, are equally elevated above the horizon, all those parts must be equally affected by refraction; but when the semidiameter is inclined to the plane of the horizon, the lower extremity will be so much more affected by refraction than the upper, as to suffer a sensible contraction, and thus cause the semidiameter, so inclined, to be something less than the horizontal semidiameter given in the N.A.; when accuracy is required, it will be necessary to attend to this contraction, but for nautical purposes the corrections in this table are sufficiently accurate.

TABLE 23.

To reduce the Moon's horizontal parallax, and semidiameter to any time under the meridian of Greenwich.

The table is to be entered with the Greenwich time, after noon or midnight, at the top, and the difference in 12 hours, in either side column, and the seconds of correction are to be added to, or subtracted from the horizontal parallax and semidiameter at the preceding noon or midnight, according as they are increasing or decreasing.

TABLE 24.

Correction of the Moon's apparent altitude.

This table contains a correction consisting of the parallax in altitude, lessened by refraction, hence, it is always to be added to the moon's apparent altitude, to obtain her true. It is to be entered with the moon's apparent altitude to the nearest less tenth minute in the left side column, and the minutes of horizontal parallax at the top, the seconds of parallax are found in the corresponding right hand part of the table, opposite to the nearest less tenth second, and under the unit seconds ; this part of the correction is to be added to that already taken out, the parts for the unit minutes of altitude are to be found at the bottom of the page, and applied as there directed.

Example.—Apparent altitude 33° 16′ and horizontal parallax 59′ 34″,

Cor. to alt. 33° 10′ and H. P. 59′ 0″		47′ 56″
Pro. parts to 34″ of H.P.	+ 28	+ 25
Do. to 6′ of alt.	— 3	
Required cor. of the moon's apparent altitude		48 21

TABLE 25.

To reduce the sun's right ascension to any given meridian, and to any time under that meridian.

This table is to be entered with the sun's right ascension at the top, and the longitude or given time in the left or right-hand side column, at the angle of meeting will be found the correction, to be applied by addition or subtraction, according to the directions at the head of the table.

TABLE 26.

Parallax of the Planets in Altitude.

This table is to be entered with the planet's horizontal parallax at the top, and the apparent altitude of the planet in one of the side columns, the corresponding seconds of correction are always to be added to the apparent altitude. This table commences at 10° altitude, but should the altitude of the planet be taken below that, the same correction may be applied to it, as stands opposite to 10°.

Or it may be calculated for by the following rule.—To the proportional logarithm of the planets horizontal parallax, add the secant of the apparent altitude, the sum rejecting 10 in the index, will be the proportional logarithm of the parallax in altitude.

Example.—Let the apparent altitude of a planet be 46°, and the horizontal parallax 26″; what will be the parallax in altitude?

Prop. log. 26″ .... = 2·6185
app. alt. 46° secant........... 10·0463

Parallax in altitude....... 24″ = 2·6648

TABLE 27.

Sun's mean right ascension.

This table is to be entered with the month at the top, and the day in either of the side columns, and will serve as a substitute for the Nautical Almanac, when very great accuracy is not required.

TABLE 28.

Correction for the altitude of the Polar Star.

This table is to be entered with the right ascension of the meridian, in one of the columns marked "R. A. mer." immediately against which, will be found the correction, which is to be added to, or subtracted from the altitude of the pole star, as directed by the precept "*add*," or "*sub*," placed over the correction: the third column contains the variation in ten years, which is always *subtractive* from the correction in the table.

TABLE 29.

Correction of the Latitude deduced from the foregoing Table.

This table is to be entered with the approximate latitude at the top, and the right ascension of the meridian in either side column; the correction is always to be added to the approximate latitude deduced from Table 28.

TABLE 30.

Log rising or Versed sines.

This table is particularly useful in finding the latitude by two altitudes of the sun, and in computing the time from the altitude of a celestial object, and many other astronomical calculations; it is to be entered with the hours at the top, the minutes in the left-hand column, and the nearest less fifth second at the top of the respective column; the proportional parts for the remaining seconds are to be taken from the right-hand marginal columns, in the compartment opposite to the logarithms taken from the body of the table; hence the time answering to the given logarithm, and the contrary, may be easily obtained to the nearest second.

Example.—Required the log. rising of 2^h 53^m 47^s.

The log. rising of 2h 53m 45s. is	4·43755
the proportional part for 2 seconds, found as directed in the right hand columns	+ 16
hence the log. rising of 2h. 53m. 47s. is	4·43771

TABLE 31.

To reduce the sun's declination to noon at any given meridian, and to any time at the meridian of Greenwich.

Take out the sun's declination for noon of the given day from page I or II of the month in the Nautical Almanac, and enter the table with this at the top, and the longitude of the place in the left-side column, or the time at Greenwich in the right-side column, the minutes and seconds corresponding to which, are to be applied as a correction to the above declination, either by addition or subtraction, according to the directions at the head of the column.

When the declination and longitude, or time at Greenwich, are not nearly found in the table, proportional parts must be taken; also if the given time at the meridian of Greenwich exceed 12 hours, the correction must be taken out at twice.

Example.—Required the sun's declination, August 21, 1852, at 16^h 48^m mean time at Greenwich.

Sun's dec. Aug. 21, at mean noon (N.A. p. ii)	12°	0′	1″
cor. for 12h.	+	10	16
cor. for 4h 48m.	+	4	6
sun's dec. at Greenwich time	12	14′	23

TABLE 32.

Natural Sines.

In this table, which contains the natural sines to every degree and minute of the quadrant, the degrees corresponding to the sines, are to be taken from the top of the page, and the minutes in the left-side columns, and the degrees answering to the co-sines from the bottom, with the minutes in the right-side column. The sines are given to six places of figures, but the sixth figure may in general be omitted, the fifth figure being increased by 1, whenever the last figure is a 5 or above a 5.

The natural sine or co-sine of any number of degrees above 90, is the same as the natural sine or co-sine of its supplement; or the natural sine or co-sine of an arc greater than 90° is the natural co-sine or sine of its excess above 90°.

TABLE 33.

Logarithms of apparent time or Horary Angle.

The logarithms in this table being arranged in the same manner as those in Table 30, the corresponding times are to be found according to the directions there given, and which it is, consequently, quite unnecessary to repeat.

TABLE 34.

Logarithms of the apparent altitudes and Horizontal Parallax.

This table is to be entered with the apparent altitude of the sun, moon, or star at the top, and the odd minutes in the right or left side column, marked ('), then under the minutes of horizontal parallax, and even with the minutes of altitude will be found the required logarithm. If there be any seconds of parallax, take the minutes of altitude in the right-hand column as seconds, and amongst these find the said seconds of parallax, against which in the extreme right-hand column, marked at the top "P.P." (proportional parts) will be found a number, which subtracted from the logarithm found as above, will give the true logarithm sought.

Example.—With the sun, moon, or star's apparent altitude 32° 42 and the moon's H.P. 59′ 14′; find the true logarithm.

The sun's alt. 32° 42′ under 59′ H. P. gives.........	7518
And 14″ of H. P.	18
Therefore the true logarithm is	7500

TABLE 35.

Proportional Logarithms.

This table contains the proportional logarithm corresponding to all portions of time under three hours, and to every second under three degrees; it derives its greatest importance from the facilities it affords, for finding the time at Greenwich, corresponding to the true distance between the moon and any other celestial object, but it is likewise applied to other important purposes.

The table is to be entered with the degrees and minutes, or hours and minutes at the top, and the seconds in either side column. Thus the proportional logarithm to 1^h 1^m 56^s is 4635; which is also the proportional logarithm to 1° 1′ 56″. The proportional logarithm to 0^h 14^m 20^s or 0° 14′ 29″ is 1·0989.

As hours and degrees are similarly divided, therefore in the general use of this table, the hours and parts of an hour, may be considered as degrees and parts of a degree, and conversely.

Since proportion is performed by adding together the arithmetical complement of the proportional logarithm of the first term, and the proportional logarithm of the second and third terms, rejecting 10 from the index; this table is of great use in reducing the altitudes of the moon, sun, or a fixed star, to the mean time and distance, when the observations are made by one person, as will be seen by referring to the worked example in the lunars, page 220.

Proportional logarithms may be calculated by the following rule, From the common logarithm of 3 hours, reduced to seconds, subtract the common logarithm of the given time in seconds; and the remainder will be the proportional logarithm corresponding to it.

Example.—Required the proportional log. answering to 1^h 50^m.

3h...... = 10800″.......log. .... 4·033424
1h. 50m. = 6600 ....log.......... 3·819544

1h. 50m..... = pro. log. .... 0·213880

Although this table is only calculated to 3 hours or degrees, yet by taking such terms as exceed those quantities, one grade lower, that is, the hours or degrees, as minutes, and the minutes as seconds, it may be extended, and applied to the reduction of the sun, moon, or planet's right ascension and declination to any given time, and likewise to the reduction of the equation.

TABLE 36.

Corrections for Apparent Altitudes and Distances..

This table is to be entered with the apparent distance at the top, and the sun or star's apparent altitude either in the line immediately under the apparent distance, or at the bottom of the table, and the apparent altitude of the moon in either of the side columns, then at the angle of meeting will be found the required correction. When the apparent distance falls between the distances given in the tables, proportions must be taken, and also in some cases of very low altitudes, but doing so will in any case be attended with very little difficulty.

TABLE 37.

Correction for Sun's Parallax.

This table contains the effect of the sun's parallax, and must be entered with the distance at the top or bottom, and the altitudes of the sun and moon in the left side column; in the angles of meeting will be found the required corrections, to be applied according to the note at the foot of the table.

TABLE 38.

Correction of the Parallax of the Planets.

The corrections in this table are derived from Table 37, and the manner of taking them out will be best understood by an example, thus,

Suppose the distance 100°, the moon's apparent altitude 25°, the altitude of Jupiter 45°, and the planet's horizontal parallax 2″.

First, even with the moon's altitude 25°, and over the given distance, 100° is found in the upper part of Table 37 - - - - - - —4
Even with the planet's altitude 45°, and over the given distance 100, is found in the lower part of the table - - —1
The sum - - - - —5

Then immediately under 5, found in the top line of this table, and even with 2″, the planet's horizontal parallax, stand 1, which is the correction for the effect of the planet's parallax on the distance; this correction is to be applied according to the note at the end of Table 37.

TABLE 39.

To find the exact Greenwich time, corresponding to a reduced lunar distance.

On account of the inequality of the moon's motion in the heavens, the interval found by the proportional logarithms, as directed in the rule page , for finding the Greenwich mean time, requires, when extreme accuracy is desired, to be corrected by a number of seconds taken from this table in the following manner;

Find the difference between the proportional logarithms standing opposite the two distances in the Nautical Almanac, between which the true distance falls, and enter the table with that difference at the top, and the approximate interval in one of the left-side columns, the corresponding seconds are the correction to be applied to the approximate interval, by *addition* when the proportional logarithms are decreasing, and by *subtraction* when they are increasing, and the result will be the true interval.

TABLE 40.

Horary Angles and Altitudes for obtaining the Time and Azimuth.

It has been observed in a former part of this work, that the most advantageous time for observing the altitude of a celestial object for the purpose of obtaining the apparent time at the meridian of a given place, is when the object bears due east or west from the observer, or when it approaches the nearest to those points, in other words, when the object is in or near the prime vertical. This table is therefore intended to determine those times, when the latitude of the place and the declination of the body are of the same name; for when they are of contrary names the object is nearest those points when in the horizon; the observation should be made when the object is at a sufficient elevation above the horizon, to clear it of the uncertain refraction incident on low altitudes, which should not be taken below 7 or 8 degrees.

This table is to be entered with the nearest degree of declination at the top, and the nearest degree of latitude in the left side column, which will give the required time from noon if the object be the *sun*, but if it be a *star*, find the time of the star's meridian passage in the Nautical Almanac, and its declination in Table 12. Then in the present table find the time corresponding to the latitude of the place and the declination of the star, which, subtracted from, or added to the time of its transit over the meridian, according as the observation is to be made before or after its transit, will give the apparent time required.

The time when a *Planet* is in or near the prime vertical, may be found in a similar manner, by taking out the mean time of its meridian passage and its declination from the proper page in the Nautical Almanac.

If the object be the moon, find the time of its meridian passage at Greenwich, in page IV of the month in the Nautical Almanac, and reduce it to the time of its passing the meridian of the given place, by Table 21, then find the corresponding time at Greenwich in the usual manner, and take out the moon's declination from the Nautical Almanac corresponding to this time, with which, and the latitude of the given place, find the time by the present table. Add to this the minutes corresponding to it and the moon's daily variation taken from Table 21, and subtract the sum from or add it to the time of the moon's meridian passage at the given place, according as the observation is to be made before or after it, and the result will be the mean time required.

The meridian passages of the moon and planets are given in the Nautical Almanac for *mean* time, the time, therefore, when they are on or near the prime vertical, may be reduced to apparent time, by applying the equation of time taken from page II of the month in the Nautical Almanac.

By this table also, the altitude of a celestial object, when in the prime vertical or at its nearest approach thereto, may be very nearly found, for which purpose the table is to be entered as before, with the declination at the top, and the latitude in the left side column, even with which, in the column marked Alt. at the top, will be found the altitude required.

TABLE 41.

Amplitudes.

By this table the true amplitude is taken out by inspection, whereby the method of finding the variation of the compass, by comparing the magnetic with the true amplitude, is very much expedited. The table is to be entered with the "Declination" at the top, and the "Lat." in the left side column, and when the minutes of the Lat. or Declination are nearly 30, or half a degree, a mean may be taken of the amplitudes found for the two nearest degrees.

TABLE 42.

Correction for the time of High Water.

This table contains a correction which is the effect of the sun's action in accelerating or retarding the time of high water, produced by the attraction of the moon. The table is to be entered with the moon's semidiameter (taken from page III of the month, in the Nautical Almanac) or the nearest to it at the top, and the time of the moon's passage over the meridian in one of the side columns so entitled. The correction is to be applied to the time of the moon's passage over the meridian by addition or subtraction, as the sign + or — is prefixed to it.

TABLE 43.

To convert intervals of mean solar time into intervals of sidereal time.

(From the Nautical Almanac.)

This table is used for converting mean solar time into sidereal time; shewing the changes of the sun's mean right ascension, in a mean solar day, or the increase of sidereal on mean solar intervals. When used for reducing the sidereal time mean noon at Greenwich, to any other meridian, the longitude must be converted into time, and then applied to the table as usual, adding the acceleration for the longitude to the sidereal time at the preceding mean noon, in west longitude, and subtracting it in east longitude.

TABLE 43 *a*.

The mean Reduction of the Moon's horizontal parallax for the spheroidal figure of the Earth.

Since it is the moon's *equatorial* horizontal parallax that is given in the Nautical Almanac, which is the angle which the Earth's equatorial semidiameter subtends, as seen from the moon, at her several varying distances from the earth, it is necessary to apply the correction from this table to it, in places distant from the equator, the parallax also varying with the distance. This reduction arises from the spheroidal figure of the earth, and where accuracy is required, it should be attended to, since the neglect of it may occasion an error of several seconds in the lunar distance, and in some instances, an error of 5′ in the longitude. For the application of the correction see page 164. The correction may be computed by the following:

Rule.—To the logarithm of the moon's horizontal parallax, reduced to seconds, add twice the logarithmic sine of the latitude, and the constant logarithm 7·52288; the sum, rejecting 10 from the index, will be the logarithm of the required reduction of parallax.

TABLE 44.

Latitudes and Longitudes of Places, &c.

This table contains the geographical positions of the principal Ports, Harbour, Capes, &c. in the World, corrected by the most recent observations, together with the time of high water on the full and change days of the moon at all the principal Ports, &c. with the vertical rise of the spring tides in feet. To this table is likewise added the principal Lighthouses, &c. with a description of the respective lights, and their heights above the level of the sea.

TABLES.

ERRATA IN TABLES.

Page		*for*		*read*
102	....	index 0·	....	index 9·
111	....	10·303010	....	10·301010
151 cor. for alt. under 3′		2″	....	3″

TABLE I.

Traverse Table to ¼ Point = 2° 49′

Dist	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	1·0	0·0	61	60·9	3·0	121	120·9	5·9	181	180·8	8·9	241	240·7	11·8
2	2·0	0·1	62	61·9	3·0	122	121·9	6·0	182	181·8	8·9	242	241·7	11·9
3	3·0	0·1	63	62·9	3·1	123	122·9	6·0	183	182·8	9·0	243	242·7	11·9
4	4·0	0·2	64	63·9	3·1	124	123·9	6·1	184	183·8	9·0	244	243·7	12·0
5	5·0	0·2	65	64·9	3·2	125	124·9	6·1	185	184·8	9·1	245	244·7	12·0
6	6·0	0·3	66	65·9	3·2	126	125·8	6·2	186	185·8	9·1	246	245·7	12·1
7	7·0	0·3	67	66·9	3·3	127	126·8	6·2	187	186·8	9·2	247	246·7	12·1
8	8·0	0·4	68	67·9	3·3	128	127·8	6·3	188	187·8	9·2	248	247·7	12·2
9	9·0	0·4	69	68·9	3·4	129	128·8	6·3	189	188·8	9·3	249	248·7	12·2
10	10·0	0·5	70	69·9	3·4	130	129·8	6·4	190	189·8	9·3	250	249·7	12·3
11	11·0	0·5	71	70·9	3·5	131	130·8	6·4	191	190·8	9·4	251	250·7	12·3
12	12·0	0·6	72	71·9	3·5	132	131·8	6·5	192	191·8	9·4	252	251·7	12·4
13	13·0	0·6	73	72·9	3·6	133	132·8	6·5	193	192·8	9·5	253	252·7	12·4
14	14·0	0·7	74	73·9	3·6	134	133·8	6·6	194	193·8	9·5	254	253·7	12·5
15	15·0	0·7	75	74·9	3·7	135	134·8	6·6	195	194·8	9·6	255	254·7	12·5
16	16·0	0·8	76	75·9	3·7	136	135·8	6·7	196	195·8	9·6	256	255·7	12·6
17	17·0	0·8	77	76·9	3·8	137	136·8	6·7	197	196·8	9·7	257	256·7	12·6
18	18·0	0·9	78	77·9	3·8	138	137·8	6·8	198	197·8	9·7	258	257·7	12·7
19	19·[illegible]	0·9	79	78·9	3·9	139	138·8	6·8	199	198·8	9·8	259	258·7	12·7
20	20·0	1·0	80	79·9	3·9	140	139·8	6·9	200	199·8	9·8	260	259·7	12·8
21	21·0	1·0	81	80·9	4·0	141	140·8	6·9	201	200·8	9·9	261	260·7	12·8
22	22·0	1·1	82	81·9	4·0	142	141·8	7·0	202	201·8	9·9	262		
23	23·0	1·1	83	82·9	4·1	143	142·8	7·0	203	202·8	10·0	263		
24	24·0	1·2	84	83·9	4·1	144	143·8	7·1	204	203·8	10·0	264		
25	25·0	1.2	85	84·9	4·2	145	144·8	7·1	205	204·8	10·1	265		
26	26·0	1·3	86	85·9	4·2	146	145·8	7·2	206	205·8	10·1	266		
27	27·0	1·3	87	86·9	4·3	147	146·8	7·2	207	206·8	10·2	267		
28	28·0	1·4	88	87·9	4·3	148	147·8	7·3	208	207·8	10·2	268		
29	29·0	1·4	89	88·9	4·4	149	148·8	7·3	209	208·8	10·3	269	[illegible]	[illegible]
30	30·0	1·5	90	89·9	4·4	150	149·8	7·4	210	209·8	10·3	270	269·7	13·3
31	31·0	1·5	91	90·9	4·5	151	150·8	7·4	211	210·7	10·4	271	270·7	13·3
32	32·0	1·6	92	91·9	4·5	152	151·8	7·5	212	211·7	10·4	272	271·7	13·3
33	33·0	1·6	93	92·9	4·6	153	152·8	7·5	213	212·7	10·5	273	272·7	13·4
34	34·0	1·7	94	93·9	4·6	154	153·8	7·6	214	213·7	10·5	274	273·7	13·4
35	35·0	1·7	95	94·9	4·7	155	154·8	7·6	215	214·7	10·6	275	274·7	13·5
36	36·0	1·8	96	95·9	4·7	156	155·8	7·7	216	215·7	10·6	276	275·7	13·5
37	37·0	1·8	97	96·9	4·8	157	156·8	7·7	217	216·7	10·7	277	276·7	13·6
38	38·0	1·9	98	97·9	4·8	158	157·8	7·8	218	217·7	10·7	278	277·7	13·6
39	39·0	1·9	99	98·9	4·9	159	158·8	7·8	219	218·7	10·8	279	278·7	13·7
40	40·0	2·0	100	99·9	4·9	160	159·8	7·9	220	219·7	10·8	280	279·7	13·7
41	41·0	2·0	101	100·9	5·0	161	160·8	7·9	221	220·7	10·8	281	280·7	13·8
42	41·9	2·1	102	101·9	5·0	162	161·8	8·0	222	221·7	10·9	282	281·7	13·8
43	42·9	2·1	103	102·9	5·1	163	162·8	8·0	223	222·7	10·9	283	282·7	13·9
44	43·9	2·2	104	103·9	5·1	164	163·8	8·1	224	223·7	11·0	284	283·7	13·9
45	44·9	2·2	105	104·9	5·2	165	164·8	8·1	225	224·7	11·0	285	284·7	14·0
46	45·9	2·3	106	105·9	5·2	166	165·8	8·2	226	225·7	11·1	286	285·7	14·0
47	46·9	2·3	107	106·9	5·3	167	166·8	8·2	227	226·7	11·1	287	286·7	14·1
48	47·9	2·4	108	107·9	5·3	168	167·8	8·2	228	227·7	11·2	288	287·7	14·1
49	48·9	2·4	109	108·9	5·4	169	168·8	8·3	229	228·7	11·2	289	288·7	14·2
50	49·9	2·5	110	109·9	5·4	170	169·8	8·3	230	229·7	11·3	290	289·7	14·2
51	50·9	2·5	111	110·9	5·5	171	170·8	8·4	231	230·7	11·3	291	290·7	14·3
52	51·9	2·6	112	111·9	5·5	172	171.8	8·4	232	231·7	11·4	292	291·7	14·3
53	52·9	2·6	113	112·9	5·5	173	172·8	8·5	233	232·7	11·4	293	292·7	14·4
54	53·9	2·7	114	113·9	5·6	174	173·8	8·5	234	233·7	11·5	294	293·6	14·4
55	54.9	2·7	115	114·9	5·6	175	174·8	8·6	235	234·7	11·5	295	294·6	14·5
56	55·9	2·8	116	115·9	5·7	176	175·8	8·6	236	235·7	11·6	296	295·6	14·5
57	56·9	2·8	117	116·9	5·7	177	176·8	8·7	237	236·7	11·6	297	296·6	14·6
58	57·9	2·9	118	117·9	5·8	178	177·8	8·7	238	237·7	11·7	298	297·6	14·6
59	58·9	2·9	119	118·9	5·8	179	178·8	8·8	239	238·7	11·7	299	298·6	14·7
60	59·9	2·9	120	119·9	5·9	180	179·8	8·8	240	239·7	11·8	300	299·6	14·7
Dist	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist	Dep.	Lat.

7¾ Points = 87° 11′

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TABLE I.

Traverse Table to ½ Point = 5° 37′

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	1·0	0·1	61	60·7	6·0	121	120·4	11·9	181	180·1	17·7	241	239·8	23·6
2	2·0	0·2	62	61·7	6·1	122	121·4	12·0	182	181·1	17·8	242	240·8	23·7
3	3·0	0·3	63	62·7	6·2	123	122·4	12·1	183	182·1	17·9	243	241·8	23·8
4	4·0	0·4	64	63·7	6·3	124	123·4	12·2	184	183·1	18·0	244	242·8	23·9
5	5·0	0·5	65	64·7	6·4	125	124·4	12·3	185	184·1	18·1	245	243·8	24·0
6	6·0	0·6	66	65·7	6·5	126	125·4	12·3	186	185·1	18·2	246	244·8	24·1
7	7·0	0·7	67	66·7	6·6	127	126·4	12·4	187	186·1	18·3	247	245·8	24·2
8	8·0	0·8	68	67.7	6·7	128	127·4	12·5	188	187·1	18·4	248	246·8	24·3
9	9·0	0·9	69	68·7	6·8	129	128·4	12·6	189	188·1	18·5	249	247·8	24·4
10	10·0	1·0	70	69·7	6·9	130	129·4	12·7	190	189·1	18·6	250	248·8	24·5
11	10·9	1·1	71	70·7	7·0	131	130·4	12·8	191	190·1	18·7	251	249·8	24·6
12	11·9	1·2	72	71·7	7·1	132	131·4	12·9	192	191·1	18·8	252	250·8	24·7
13	12·9	1·3	73	72·6	7·2	133	132·4	13·0	193	192·1	18·9	253	251·8	24·8
14	13·9	1·4	74	73·6	7·3	134	133·3	13·1	194	193·1	19·0	254	252·8	24·9
15	14·9	1·5	75	74·6	7·4	135	134·3	13·2	195	194·1	19·1	255	253·8	25·0
16	15·9	1·6	76	75·6	7·4	136	135·3	13·3	196	195·1	19·2	256	254·8	25·1
17	16·9	1·7	77	76·6	7·5	137	136·3	13·4	197	196·1	19·3	257	255·8	25·2
18	17·9	1·8	78	77·6	7·6	138	137·3	13·5	198	197·0	19·4	258	256·8	25·3
19	18·9	1·9	79	78·6	7·7	139	138·3	13·6	199	198·0	19·5	259	257·8	25·4
20	19·9	2·0	80	79·6	7·8	140	139·3	13·7	200	199·0	19·6	260	258·7	25·5
21	20·9	2·1	81	80·6	7·9	141	140·3	13·8	201	200·0	19·7	261	259·7	25·6
22	21·9	2·2	82	81·6	8·0	142	141·3	13·9	202	201·0	19·8	262	260·7	25·7
23	22·9	2.3	83	82·6	8·1	143	142·3	14·0	203	202·0	19·9	263	261·7	25·8
24	23·9	2·4	84	83·6	8·2	144	143·3	14·1	204	203·0	20·0	264	262·7	25·9
25	24·9	2·4	85	84·6	8·3	145	144·3	14·2	205	204·0	20·1	265	263·7	26·0
26	25·9	2·5	86	85·6	8·4	146	145·3	14·3	206	205·0	20·2	266	264·7	26·1
27	26·9	2·6	87	86·6	8·5	147	146·3	14·4	207	206·0	20·3	267	265·7	26·2
28	27·9	2·7	88	87·6	8·6	148	147·3	14·5	208	207·0	20·4	268	266·7	26·3
29	28·9	2·8	89	88·6	8·7	149	148·3	14·6	209	208·0	20·5	269	267·7	26·4
30	29·9	2·9	90	89·6	8·8	150	149·3	14·7	210	209·0	20·6	270	268·7	26·5
31	30·9	3·0	91	90·6	8·9	151	150·3	14·8	211	210·0	20·7	271	269·7	26·6
32	31·8	3·1	92	91·6	9·0	152	151·3	14·9	212	211·0	20·8	272	270·7	26·7
33	32·8	3·2	93	92·6	9·1	153	152·3	15·0	213	212·0	20·9	273	271·7	26·8
34	33·8	3·3	94	93·5	9·2	154	153·3	15·1	214	213·0	21·0	274	272·7	26·9
35	34·8	3·4	95	94·5	9·3	155	154·3	15·2	215	214·0	21·1	275	273·7	27·0
36	35·8	3·5	96	95·5	9·4	156	155·2	15·3	216	215·0	21·2	276	274·7	27·1
37	36·8	3·6	97	96·5	9·5	157	156·2	15·4	217	216·0	21·3	277	275·7	27·2
38	37·8	3·7	98	97·5	9·6	158	157·2	15·5	218	216·9	21·4	278	276·7	27·3
39	38·8	3·8	99	98·5	9·7	159	158·2	15·6	219	217·9	21·5	279	277·7	27·4
40	39·8	3·9	100	99·5	9·8	160	159·2	15·7	220	218·9	21·6	280	278·7	27·5
41	40·8	4·0	101	100·5	9·9	161	160·2	15·8	221	219·9	21·7	281	279·6	27·5
42	41·8	4·1	102	101·5	10·0	162	161·2	15·9	222	220·9	21·8	282	280·6	27·6
43	42·8	4·2	103	102·5	10·1	163	162·2	16·0	223	221·9	21·9	283	281·6	27·7
44	43·8	4·3	104	103·5	10·2	164	163·2	16·1	224	222·9	22·0	284	282·6	27·8
45	44·8	4·4	105	104·5	10·3	165	164·2	16·2	225	223·9	22·1	285	283·6	27·9
46	45·8	4·5	106	105·5	10·4	166	165·2	16·3	226	224·9	22.2	286	284·6	28·0
47	46·8	4·6	107	106·5	10·5	167	166·2	16.4	227	225·9	22·2	287	285·6	28·1
48	47·8	4·7	108	107·5	10·6	168	167·2	16·5	228	226·9	22·3	288	286·6	28·2
49	48·8	4·8	109	108·5	10·7	169	168·2	16·6	229	227·9	22·4	289	287·6	28·3
50	49·8	4·9	110	109·5	10·8	170	169·2	16·7	230	228·9	22·5	290	288·6	28·4
51	50·8	5·0	111	110·5	10·9	171	170·2	16·8	231	229·9	22·6	291	289·6	28·5
52	51·7	5·1	112	111·5	11·0	172	171·2	16·9	232	230·9	22·7	292	290·6	28·6
53	52·7	5·2	113	112·5	11·1	173	172·2	17·0	233	231·9	22·8	293	291·6	28·7
54	53·7	5·3	114	113·5	11·2	174	173·2	17·1	234	232·9	22·9	294	292·6	28·8
55	54·7	5·4	115	114·4	11·3	175	174·2	17·2	235	233·9	23·0	295	293·6	28·9
56	55·7	5·5	116	115·4	11·4	176	175·2	17·3	236	234·9	23·1	296	294·6	29·0
57	56·7	5·6	117	116·4	11·5	177	176·2	17·4	237	235·9	23·2	297	295·6	29·1
58	57·7	5·7	118	117·4	11·6	178	177·1	17·4	238	236·9	23·3	298	296·6	29·2
59	58·7	5·8	119	118·4	11·7	179	178·1	17·5	239	237·8	23·4	299	297·6	29·3
60	59·7	5·9	120	119·4	11·8	180	179·1	17·6	240	238·8	23·5	300	298·6	29·4
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

7½ Points = 84° 22′

TABLE I.

Traverse Table to ¾ Point = 8° 26′

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	1·0	0·1	61	60·3	9·0	121	119·7	17·8	181	179·0	26·6	241	238·4	35·4
2	2·0	0·3	62	61·3	9·1	122	120·7	17·9	182	180·0	26·7	242	239·4	35·5
3	3·0	0·4	63	62·3	9·2	123	121·7	18·1	183	181·0	26·9	243	240·4	35·7
4	4·0	0·6	64	63·3	9·4	124	122·7	18·2	184	182·0	27·0	244	241·4	35·8
5	4·9	0·7	65	64·3	9·5	125	123·7	18·3	185	183·0	27·2	245	242·4	36·0
6	5·9	0·9	66	65·3	9·7	126	124·6	18·5	186	184·0	27·3	246	243·3	36·1
7	6·9	1·0	67	66·3	9·8	127	125·6	18·6	187	185·0	27·4	247	244·3	36·2
8	7·9	1·2	68	67·3	10·0	128	126·6	18·8	188	186·0	27·6	248	245·3	36·4
9	8·9	1·3	69	68·3	10·1	129	127·6	18·9	189	187·0	27·7	249	246·3	36·5
10	9·9	1·5	70	69·2	10·3	130	128·6	19·1	190	187·9	27·9	250	247·3	36·7
11	10·9	1·6	71	70·2	10·4	131	129·6	19·2	191	188·9	28·0	251	248·3	36·8
12	11·9	1·8	72	71·2	10·6	132	130·6	19·4	192	189·9	28·2	252	249·3	37·0
13	12·9	1·9	73	72·2	10·7	133	131·6	19·5	193	190·9	28·3	253	250·3	37·1
14	13·9	2·1	74	73·2	10·9	134	132·6	19·7	194	191·9	28·5	254	251·3	37·3
15	14·8	2·2	75	74·2	11·0	135	133·5	19·8	195	192·9	28·6	255	252·2	37·4
16	15·8	2·3	76	75·2	11·2	136	134·5	20·0	196	193·9	28·8	256	253·2	37·6
17	16·8	2·5	77	76·2	11·3	137	135·5	20·1	197	194·9	28·9	257	254·2	37·7
18	17·8	2·6	78	77·2	11·4	138	136·5	20·3	198	195·9	29·1	258	255·2	37·9
19	18·8	2·8	79	78·1	11·6	139	137·5	20·4	199	196·8	29·2	259	256·2	38·0
20	19·8	2·9	80	79·1	11·7	140	138·5	20·5	200	197·8	29.4	260	257·2	38·2
21	20·8	3·1	81	80·1	11·9	141	139·5	20·7	201	198·8	29·5	261	258·2	38·3
22	21·8	3·2	82	81·1	12·0	142	140·5	20·8	202	199·8	29·6	262	259·2	38·4
23	22·8	3·4	83	82·1	12·2	143	141·5	21·0	203	200·8	29·8	263	260·2	38·6
24	23·7	3·5	84	83·1	12·3	144	142·4	21·1	204	201·8	29·9	264	261·1	38·7
25	24·7	3·7	85	84·1	12·5	145	143·4	21·3	205	202·8	30·1	265	262·1	38·9
26	25·7	3·8	86	85·1	12·6	146	144·4	21·4	206	203·8	30·2	266	263·1	39·0
27	26·7	4·0	87	86·1	12·8	147	145·4	21·6	207	204·8	30·4	267	264·1	39·2
28	27·7	4·1	88	87·1	12·9	148	146·4	21·7	208	205·8	30·5	268	265·1	39·3
29	28·7	4·3	89	88·0	13·1	149	147·4	21·9	209	206·7	30·7	269	266·1	39·5
30	29·7	4·4	90	89·0	13·2	150	148·4	22·0	210	207·7	30·8	270	267·1	39·6
31	30·7	4·6	91	90·0	13·4	151	149·4	22·2	211	208·7	31·0	271	268·1	39·8
32	31·7	4·7	92	91·0	13·5	152	150·4	22·3	212	209·7	31·1	272	269·1	39·9
33	32·6	4·8	93	92·0	13·7	153	151·3	22·5	213	210·7	31·3	273	270·0	40·1
34	33·6	5·0	94	93·0	13·8	154	152·3	22·6	214	211·7	31·4	274	271·0	40·3
35	34·6	5·1	95	94·0	13·9	155	153·3	22·7	215	212·7	31·6	275	272·0	40·4
36	35·6	5·3	96	95·0	14·1	156	154·3	22·9	216	213·7	31·7	276	273·0	40·5
37	36·6	5·4	97	96·0	14·2	157	155·3	23·0	217	214·7	31·8	277	274·0	40·6
38	37·6	5·6	98	96·9	14·4	158	156·3	23·2	218	215·6	32·0	278	275·0	40·8
39	38·6	5·8	99	97·9	14·5	159	157·3	23·3	219	216·6	32·1	279	276·0	40·9
40	39·6	5·9	100	98·9	14·7	160	158·3	23·5	220	217·6	32·3	280	277·0	41·1
41	40·6	6·0	101	99·9	14·8	161	159·3	23·6	221	218·6	32·4	281	278·0	41·2
42	41·6	6·2	102	100·9	15·0	162	160·3	23·8	222	219·6	32·6	282	279·0	41·4
43	42·5	6·3	103	101·9	15·1	163	161·2	23·9	223	220·6	32·7	283	279·9	41·5
44	43·5	6·5	104	102·9	15.3	164	162·2	24·1	224	221·6	32·9	284	280·9	41·7
45	44·5	6·6	105	103·9	15·4	165	163·2	24·2	225	222·6	33·0	285	281·9	41·8
46	45·5	6·8	106	104·9	15·6	166	164·2	24·4	226	223·6	33·2	286	282·9	42·0
47	46·5	6·9	107	105·8	15·7	167	165·2	24·5	227	224·5	33·3	287	283·9	42·1
48	47·5	7·0	108	106·8	15·9	168	166·2	24·7	228	225·5	33·5	288	284·9	42·3
49	48·5	7·2	109	107·8	16·0	169	167·2	24·8	229	226·5	33·6	289	285·9	42·4
50	49·5	7·3	110	108·8	16·1	170	168·2	24·9	230	227·5	33·8	290	286·9	42·6
51	50·5	7·5	111	109·8	16·3	171	169·2	25·1	231	228·5	33·9	291	287·9	42·7
52	51·5	7·6	112	110·8	16·4	172	170·1	25·2	232	229·5	34·0	292	288·8	42·9
53	52·4	7·8	113	111·8	16·6	173	171·1	25.4	233	230·5	34·2	293	289·8	43·0
54	53·4	7·9	114	112·8	16·7	174	172·1	25·5	234	231·5	34·3	294	290·8	43·1
55	54·4	8·1	115	113·8	16·9	175	173·1	25·7	235	232·5	34.5	295	291·8	43·3
56	55·4	8·2	116	114·7	17·0	176	174·1	25·8	236	233·4	34·6	296	292·8	43·4
57	56·4	8·4	117	115·7	17·2	177	175·1	26·0	237	234·4	34·8	297	293·8	43·6
58	57·4	8·5	118	116·7	17·3	178	176·1	26·1	238	235·4	34·9	298	294·8	43·7
59	58·4	8·7	119	117·7	17·5	179	177·1	26·3	239	236·4	35·1	299	295·8	43·9
60	59·4	8·8	120	118·7	17·6	180	178·1	26·4	240	237·4	35·2	300	296·8	44·0
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

TABLE I.

Traverse Table to 1 Point = 11° 15′

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	1·0	0·2	61	59·8	11·9	121	118·7	23·6	181	177·5	35·3	241	236·4	47·0
2	2·0	0·4	62	60·8	12·1	122	119·7	23·8	182	178·5	35·5	242	237·4	47·2
3	2·9	0·6	63	61·8	12·3	123	120·6	24·0	183	179·5	35·7	243	238·3	47·4
4	3·9	0·8	64	62·8	12·5	124	121·6	24·2	184	180·5	35·9	244	239·3	47·6
5	4·9	1·0	65	63·8	12·7	125	122·6	24·4	185	181·5	36·1	245	240·3	47·8
6	5·9	1·2	66	64·7	12·9	126	123·6	24·6	186	182·4	36·3	246	241·3	48·0
7	6·9	1·4	67	65·7	13·1	127	124·6	24·8	187	183·4	36·5	247	242·3	48·2
8	7·8	1·6	68	66·7	13·3	128	125·5	25·0	188	184·4	36·7	248	243·2	48·4
9	8·8	1·8	69	67·7	13·5	129	126·5	25·2	189	185·4	36·9	249	244·2	48·6
10	9·8	2·0	70	68·7	13·7	130	127·5	25·4	190	186·4	37·1	250	245·2	48·8
11	10·8	2·1	71	69·6	13·9	131	128·5	25·6	191	187·3	37·3	251	246·2	49·0
12	11·8	2·3	72	70·6	14·0	132	129·5	25·8	192	188·3	37·5	252	247·2	49·2
13	12·8	2·5	73	71·6	14·2	133	130·5	26·0	193	189·3	37·7	253	248·1	49·4
14	13·7	2·7	74	72·6	14·4	134	131·4	26·1	194	190·3	37·8	254	249·1	49·6
15	14·7	2·9	75	73·6	14·6	135	132·4	26·3	195	191·3	38·0	255	250·1	49·7
16	15·7	3·1	76	74·5	14·8	136	133·4	26·5	196	192·2	38·2	256	251·1	49·9
17	16·7	3·3	77	75·5	15·0	137	134·4	26·7	197	193·2	38·4	257	252·1	50·1
18	17·7	3·5	78	76·5	15·2	138	135·4	26·9	198	194·2	38·6	258	253·0	50·3
19	18·6	3·7	79	77·5	15·4	139	136·3	27·1	199	195·2	38·8	259	254·0	50·5
20	19·6	3·9	80	78·5	15·6	140	137·3	27·3	200	196·2	39·0	260	255·0	50·7
21	20·6	4·1	81	79·4	15·8	141	138·3	27·5	201	197·1	39·2	261	256·0	50·9
22	21·6	4·3	82	80·4	16·0	142	139·3	27·7	202	198·1	39·4	262	257·0	51·1
23	22·6	4·5	83	81·4	16·2	143	140·3	27·9	203	199·1	39·6	263	258·0	51·3
24	23·5	4·7	84	82·4	16·4	144	141·2	28·1	204	200·1	39·8	264	258·9	51·5
25	24·5	4·9	85	83·4	16·6	145	142·2	28·3	205	201·1	40·0	265	259·9	51·7
26	25·5	5·1	86	84·4	16·8	146	143·2	28·5	206	202·0	40·2	266	260·9	51·9
27	26·5	5·3	87	85·3	17·0	147	144·2	28·7	207	203·0	40·4	267	261·9	52·1
28	27·5	5·5	88	86·3	17·2	148	145·2	28·9	208	204·0	40·6	268	262·9	52·3
29	28·4	5·7	89	87·3	17·4	149	146·1	29·1	209	205·0	40·8	269	263·8	52·5
30	29·4	5.9	90	88·3	17·6	150	147·1	29·3	210	206·0	41·0	270	264·8	52·7
31	30·4	6·0	91	89·2	17·8	151	148·1	29·5	211	207·0	41·2	271	265·8	52·9
32	31·4	6·2	92	90·2	18·0	152	149·1	29·7	212	207·9	41·4	272	266·8	53·1
33	32·4	6·4	93	91·2	18·1	153	150·1	29·9	213	208·9	41·6	273	267·8	53·3
34	33·3	6·6	94	92·2	18·3	154	151·0	30·0	214	209·9	41·8	274	268·7	53·5
35	34·3	6·8	95	93·2	18·5	155	152·0	30·2	215	210·9	41·9	275	269·7	53·6
36	35·3	7·0	96	94·2	18·7	156	153·0	30·4	216	211·9	42·1	276	270·7	53·8
37	36·3	7·2	97	95·1	18·9	157	154·0	30·6	217	212·8	42·3	277	271·7	54·0
38	37·3	7·4	98	96·1	19·1	158	155·0	30·8	218	213·8	42·5	278	272·7	54·2
39	38·3	7·6	99	97·1	19·3	159	156·0	31·0	219	214·8	42·7	279	273·6	54·4
40	39·2	7·8	100	98·1	19·5	160	156·9	31·2	220	215·8	42·9	280	274·6	54·6
41	40·2	8·0	101	99·1	19·7	161	157·9	31·4	221	216·8	43·1	281	275·6	54·8
42	41·2	8·2	102	100·0	19·9	162	158·9	31·6	222	217·7	43·3	282	276·6	55·0
43	42·2	8·4	103	101·0	20·1	163	159·9	31·8	223	218·7	43·5	283	277·6	55·2
44	43·2	8·6	104	102·0	20·3	164	160·9	32·0	224	219·7	43·7	284	278·5	55·4
45	44·1	8·8	105	103·0	20·5	165	161·8	32·2	225	220·7	43·9	285	279·5	55·6
46	45·1	9·0	106	104·0	20·7	166	162·8	32·4	226	221·7	44·1	286	280·5	55·8
47	46·1	9·2	107	104·9	20·9	167	163·8	32·6	227	222·6	44·3	287	281·5	56·0
48	47·1	9·4	108	105·9	21·1	168	164·8	32·8	228	223·6	44·5	288	282·5	56·2
49	48·1	9·6	109	106·9	21·3	169	165·8	33·0	229	224·6	44·7	289	283·5	56·4
50	49·0	9·8	110	107·9	21·5	170	166·7	33·2	230	225·6	44·9	290	284·4	56·6
51	50·0	10·0	111	108·9	21·7	171	167·7	33·4	231	226·6	45·1	291	285·4	56·8
52	51·0	10·1	112	109·9	21·9	172	168·7	33·6	232	227·5	45·3	292	286·4	57·0
53	52·0	10·3	113	110·8	22·0	173	169·7	33·8	233	228·5	45·5	293	287·4	57·2
54	53·0	10·5	114	111·8	22·2	174	170·7	34·0	234	229·5	45·7	294	288·4	57·4
55	53·9	10·7	115	112·8	22·4	175	171·6	34·1	235	230·5	45·9	295	289·3	57·6
56	54·9	10·9	116	113·8	22·6	176	172·6	34·3	236	231·5	46·0	296	290·3	57·7
57	55·9	11·1	117	114·8	22·8	177	173·6	34·5	237	232·5	46·2	297	291·3	57·9
58	56·9	11·3	118	115·7	23·0	178	174·6	34·7	238	233·4	46·4	298	292·3	58·1
59	57·9	11·5	119	116·7	23·2	179	175·6	34·9	239	234·4	46·6	299	293·3	58·3
60	58·8	11·7	120	117·7	23·4	180	176·5	35·1	240	235·4	46·8	300	294·2	58·5
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

7 Points = 78° 45′

TABLE I.

Traverse Table to 1¼ Points = 14° 4′

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	1·0	0·2	61	59·2	14·8	121	117·4	29·4	181	175·6	44·0	241	233·8	58·6
2	1·9	0·5	62	60·1	15·1	122	118·4	29·6	182	176·5	44·2	242	234·8	58·8
3	2·9	0·7	63	61·1	15·3	123	119·3	29·9	183	177·5	44·5	243	235·7	59·0
4	3·9	1·0	64	62·1	15·6	124	120·3	30·1	184	178·5	44·7	244	236·7	59·3
5	4·9	1·2	65	63·1	15·8	125	121·3	30·4	185	179·5	45·0	245	237·7	59·5
6	5·8	1·5	66	64·0	16·0	126	122·2	30·6	186	180·4	45·2	246	238·6	59·8
7	6·8	1·7	67	65·0	16·3	127	123·2	30·9	187	181·4	45·4	247	239·6	60·0
8	7·8	1·9	68	66·0	16·5	128	124·2	31·1	188	182·4	45·7	248	240·6	60·3
9	8·7	2·2	69	66·9	16·8	129	125·1	31·3	189	183·3	45·9	249	241·6	60·5
10	9·7	2·5	70	67·9	17·0	130	126·1	31·6	190	184·3	46·2	250	242·5	60·8
11	10·7	2·7	71	68·9	17·3	131	127·1	31·8	191	185·3	46·4	251	243·5	61·0
12	11·6	2·9	72	69·9	17·5	132	128·1	32·1	192	186·2	46·7	252	244·5	61·2
13	12·6	3·2	73	70·8	17·7	133	129·0	32·3	193	187·2	46·9	253	245·4	61·5
14	13·6	3·4	74	71·8	18·0	134	130·0	32·6	194	188·2	47·1	254	246·4	61·7
15	14·6	3·6	75	72·8	18·2	135	131·0	32·8	195	189·2	47·4	255	247·4	62·0
16	15·5	3·9	76	73·7	18·5	136	131·9	33·1	196	190·1	47·6	256	248·3	62·2
17	16·5	4·1	77	74·7	18·7	137	132·9	33·3	197	191·1	47·9	257	249·3	62·5
18	17·5	4·4	78	75·7	19·0	138	133·9	33·5	198	192·1	48·1	258	250·3	62·7
19	18·4	4·6	79	76·6	19·2	139	134·8	33·8	199	193·0	48·4	259	251·3	62·9
20	19·4	4.9	80	77·6	19·4	140	135·8	34.0	200	194·0	48·6	260	252·2	63·2
21	20·4	5·1	81	78·6	19·7	141	136·8	34·3	201	195·0	48·8	261	253·2	63·4
22	21·3	5·4	82	79·6	19·9	142	137·8	34·5	202	196·0	49·1	262	254·2	63·7
23	22·3	5·6	83	80·5	20·2	143	138·7	34·8	203	196·9	49·3	263	255·1	63·9
24	23·3	5·8	84	81·5	20·4	144	139·7	35·0	204	197·9	49·6	264	256·1	64·2
25	24·3	6·1	85	82·5	20·7	145	140·7	35·2	205	198·9	49·8	265	257·1	64·4
26	25·2	6·3	86	83·4	20·9	146	141·6	35·5	206	199·8	50·1	266	258·0	64·6
27	26·2	6·6	87	84·4	21·1	147	142·6	35·7	207	200·8	50·3	267	259·0	64·9
28	27·2	6·8	88	85·4	21·4	148	143·6	36·0	208	201·8	50·5	268	260·0	65·1
29	28·1	7·1	89	86·3	21·6	149	144·5	36·2	209	202·7	50·8	269	261·0	65·4
30	29·1	7·3	90	87·3	21·9	150	145·5	36·5	210	203·7	51·0	270	261·9	65·6
31	30·1	7·5	91	88·3	22·1	151	146·5	36·7	211	204·7	51·3	271	262·9	65·9
32	31·0	7·8	92	89·3	22·4	152	147·4	36·9	212	205·7	51·5	272	263·9	66·1
33	32·0	8·0	93	90·2	22·6	153	148·4	37·2	213	206·6	51·8	273	264·8	66·3
34	33·0	8·3	94	91·2	22·8	154	149·4	37·4	214	207·6	52·0	274	265·8	66·6
35	34·0	8·5	95	92·2	23·1	155	150·4	37·7	215	208·6	52·2	275	266·8	66·8
36	34·9	8·8	96	93·1	23·3	156	151·3	37·9	216	209·5	52·5	276	267·7	67·1
37	35·9	9·0	97	94·1	23·6	157	152·3	38·2	217	210·5	52·7	277	268·7	67·3
38	36·9	9·2	98	95·1	23·8	158	153·3	38·4	218	211·5	53·0	278	269·7	67·6
39	37·8	9·5	99	96·0	24·1	159	154·2	38·6	219	212·5	53·2	279	270·7	67·8
40	38·8	9·6	100	97·0	24·3	160	155·2	38·9	220	213·4	53·5	280	271·6	68·0
41	39·8	10·0	101	98·0	24·5	161	156·2	39·1	221	214·4	53·7	281	272·6	68·3
42	40·7	10·2	102	99·0	24·8	162	157·2	39·4	222	215·4	53·9	282	273·6	68·5
43	41·7	10·5	103	99·9	25·0	163	158·1	39·6	223	216·3	54·2	283	274·5	68·8
44	42·7	10·7	104	100·9	25·2	164	159·1	39·9	224	217·3	54·4	284	275·5	69·0
45	43·7	10·9	105	101·9	25·5	165	160·1	40·1	225	218·3	54·7	285	276·5	69·3
46	44·6	11·2	106	102·8	25·8	166	161·0	40·3	226	219·2	54·9	286	277·4	69·5
47	45·6	11·4	107	103·8	26·0	167	162·0	40·6	227	220·2	55·2	287	278·4	69·7
48	46·6	11·7	108	104·8	26·2	168	163·0	40·8	228	221·2	55·4	288	279·4	70·0
49	47·5	11·9	109	105·7	26·5	169	163·9	41·1	229	222·2	55·6	289	280·4	70·2
50	48·5	12·2	110	106·7	26·7	170	164·9	41·3	230	223·1	55·9	290	281·3	70·5
51	49·5	12·4	111	107·7	27·0	171	165·9	41·6	231	224·1	56·1	291	282·3	70·7
52	50·4	12·6	112	108·7	27·2	172	166·9	41·8	232	225·1	56·4	292	283·3	71·0
53	51·4	12·7	113	109·6	27·5	173	167·8	42·0	233	226·0	56·6	293	284·2	71·2
54	52·4	13·1	114	110·6	27·7	174	168·8	42·3	234	227·0	56·9	294	285·2	71·4
55	53·4	13·4	115	111·6	27·9	175	169·8	42·5	235	228·0	57·1	295	286·2	71·7
56	54·3	13·6	116	112·5	28·2	176	170·7	42·8	236	228·9	57·3	296	287·1	71·9
57	55·3	13·9	117	113·5	28·4	177	171·7	43·0	237	229·9	57·6	297	288·1	72·2
58	56·3	14·1	118	114·5	28·7	178	172·7	43·3	238	230·9	57·8	298	289·1	72·4
59	57·2	14·3	119	115·4	28·9	179	173·6	43·5	239	231·8	58·1	299	290·1	72·7
60	58·2	14·6	120	116·4	29·2	180	174·6	43·7	240	232·8	58·3	300	291·0	72·9
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

6¾ Points = 75° 56′

TABLE I.

Traverse Table to 1½ Points = 16° 52′

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	1·0	0·3	61	58·4	17·7	121	115·8	35·1	181	173·2	52·5	241	230·6	70·0
2	1·9	0·6	62	59·3	18·0	122	116·8	35·4	182	174·2	52·8	242	231·6	70·3
3	2·9	0·9	63	60·3	18·3	123	117·7	35·7	183	175·1	53·1	243	232·5	70·5
4	3·8	1·2	64	61·2	18·6	124	118·7	36·0	184	176·1	53·4	244	233·5	70·8
5	4·8	1·5	65	62·2	18·9	125	119·6	36·3	185	177·0	53·7	245	234·5	71·1
6	5·7	1·7	66	63·2	19·2	126	120·6	36·6	186	178·0	54·0	246	235·4	71·4
7	6·7	2·0	67	64·1	19·5	127	121·5	36·9	187	179·0	54·3	247	236·4	71·7
8	7·7	2·3	68	65·1	19·7	128	122·5	37·2	188	179·9	54·6	248	237·3	72·0
9	8·6	2·6	69	66·0	20·0	129	123·5	37·5	189	180·9	54·9	249	238·3	72·3
10	9·6	2·9	70	67·0	20·3	130	124·4	37·7	190	181·8	55·2	250	239·2	72·6
11	10·5	3·2	71	67·9	20·6	131	125·4	38·0	191	182·8	55·4	251	240·2	72·9
12	11·5	3·5	72	68·9	20·9	132	126·3	38·3	192	183·7	55·7	252	241·2	73·2
13	12·4	3·8	73	69·9	21·2	133	127·3	38·6	193	184·7	56·0	253	242·1	73·4
14	13·4	4·1	74	70·8	21·5	134	128·2	38·9	194	185·7	56·3	254	243·1	73·7
15	14·4	4·4	75	71·8	21·8	135	129·2	39·2	195	186·6	56·6	255	244·0	74·0
16	15·3	4·6	76	72·7	22·1	136	130·1	39·5	196	187·6	56·9	256	245·0	74·3
17	16·3	4·9	77	73·7	22·4	137	131·1	39·8	197	188·5	57·2	257	245·9	74·6
18	17·2	5·2	78	74·6	22·6	138	132·1	40·1	198	189·5	57·5	258	246·9	74·9
19	18·2	5·5	79	75·6	22·9	139	133·0	40·4	199	190·4	57·8	259	247·9	75·2
20	19·1	5·8	80	76·6	23·2	140	134·0	40·6	200	191·4	58·1	260	248·8	75·5
21	20·1	6·1	81	77·5	23·5	141	134·9	40·9	201	192·3	58·4	261	249·8	75·8
22	21·1	6·4	82	78·5	23·8	142	135·9	41·2	202	193·3	58·6	262	250·7	76·1
23	22·0	6·7	83	79·4	24·1	143	136·8	41·5	203	194·3	58 9	263	251·7	76·3
24	23·0	7·0	84	80·4	24·4	144	137·8	41·8	204	195·2	59·2	264	252·6	76·6
25	23·9	7·3	85	81·3	24·7	145	138·8	42·1	205	196·2	59·5	265	253·6	76·9
26	24·9	7·5	86	82·3	25·0	146	139·7	42·4	206	197·1	59·8	266	254·6	77·2
27	25·8	7·8	87	83·3	25·3	147	140·7	42·7	207	198·1	60·1	267	255·5	77·5
28	26·8	8·1	88	84·2	25·5	148	141·6	43·0	208	199·0	60·4	268	256·5	77·8
29	27·8	8·4	89	85·2	25·8	149	142·6	43·3	209	200·0	60·7	269	257·4	78·1
30	28·7	8·7	90	86·1	26·1	150	143·5	43·5	210	201·0	61·0	270	258·4	78·4
31	29·7	9·0	91	87·1	26·4	151	144·5	43·8	211	201·9	61·3	271	259·3	78·7
32	30·6	9·3	92	88·0	26·7	152	145·5	44·1	212	202·9	61·5	272	260·3	79·0
33	31·6	9·6	93	89·0	27·0	153	146·4	44·4	213	203·8	61·8	273	261·2	79·3
34	32·5	9·9	94	90·0	27·3	154	147·4	44·7	214	204·8	62·1	274	262·2	79·5
35	33·5	10·2	95	90·9	27·6	155	148·3	45·0	215	205·7	62·4	275	263·2	79·8
36	34·5	10·5	96	91·9	27·9	156	149·3	45·3	216	206·7	62·7	276	264·1	80·1
37	35·4	10·7	97	92·8	28·2	157	150·2	45·6	217	207·7	63·0	277	265·1	80·4
38	36·4	11·0	98	93·8	28·5	158	151·2	45·9	218	208·6	63·2	278	266·0	80·7
39	37·3	11·3	99	94·7	28·7	159	152·2	46·2	219	209·6	63·6	279	267·0	81·0
40	38·3	11·6	100	95·7	29·0	160	153·1	46·4	220	210·5	63·9	280	267·9	81·3
41	39·2	11·9	101	96·7	29·3	161	154·1	46·7	221	211·5	64·2	281	268·9	81·6
42	40·2	12·2	102	97·6	29·6	162	155·0	47·0	222	212·4	64·4	282	269·9	81·9
43	41·2	12·5	103	98·6	29·9	163	156·0	47·3	223	213·4	64·7	283	270·8	82·2
44	42·1	12·8	104	99·5	30·2	164	156·9	47·6	224	214·4	65·0	284	271·8	82·4
45	43·1	13·1	105	100·5	30·5	165	157·9	47·9	225	215·3	65·3	285	272·7	82·7
46	44·0	13·4	106	101·4	30·8	166	158·9	48·2	226	216·3	65·6	286	273·7	83·0
47	45·0	13·6	107	102·4	31·1	167	159·8	48·5	227	217·2	65·9	287	274·6	83·3
48	45·9	13·9	108	103·4	31·4	168	160·8	48·8	228	218·2	66·2	288	275·6	83·6
49	46·9	14·2	109	104·3	31·6	169	161·7	49·1	229	219·1	66·5	289	276·6	83·9
50	47·9	14·5	110	105·3	31·9	170	162·7	49·4	230	220·1	66·8	290	277·5	84·2
51	48·8	14·8	111	106·2	32·2	171	163·6	49·6	231	221·1	67·1	291	278·5	84·5
52	49·8	15·1	112	107·2	32·5	172	164·6	49·9	232	222·0	67·3	292	279·4	84·8
53	50·7	15·4	113	108·1	32·8	173	165·6	50·2	233	223·0	67·6	293	280·4	85·0
54	51·7	15·7	114	109·1	33·1	174	166·5	50·5	234	223·9	67·9	294	281·3	85·3
55	52·6	16·0	115	110·1	33·4	175	167·5	50·8	235	224·9	68·2	295	282·3	85·6
56	53·6	16·3	116	111·0	33·7	176	168·4	51·1	236	225·8	68·5	296	283·3	85·9
57	54·6	16·6	117	112·0	34·0	177	169·4	51·4	237	226·8	68·8	297	284·2	86·2
58	55·5	16·8	118	112·9	34·3	178	170·3	51·7	238	227·8	69·1	298	285·2	86·5
59	56·5	17·1	119	113·9	34·5	179	171·3	52·0	239	228·7	69·4	299	286·1	86·8
60	57·4	17·4	120	114·8	34·8	180	172·3	52·3	240	229·7	69·7	300	287·1	87·1
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

6½ Points = 73° 7′

TABLE I.

Traverse Table to 1¾ Points = 19° 41′

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	0·9	0·3	61	57·4	20·6	121	113·9	40·8	181	170·4	61·0	241	226·9	81·2
2	1·9	0·7	62	58·4	20·9	122	114·9	41·1	182	171·4	61·3	242	227·9	81·5
3	2·8	1·0	63	59·3	21·2	123	115·8	41·4	183	172·3	61·7	243	228·8	81·9
4	3·8	1·4	64	60·3	21·6	124	116·8	41·8	184	173·2	62·0	244	229·7	82·2
5	4·7	1·7	65	61·2	21·9	125	117·7	42·1	185	174·2	62·3	245	230·7	82·5
6	5·7	2·0	66	62·1	22·2	126	118·6	42·5	186	175·1	62·7	246	231·6	82·9
7	6·6	2·4	67	63·1	22·6	127	119·6	42·8	187	176·1	63·0	247	232·6	83·2
8	7·5	2·7	68	64·0	22·9	128	120·5	43·1	188	177·0	63·3	248	233·5	83·6
9	8·5	3·0	69	65·0	23·3	129	121·5	43·5	189	177·9	63·7	249	234·4	83·9
10	9·4	3·4	70	65·9	23·6	130	122·4	43·8	190	178·9	64·0	250	235·4	84·2
11	10·4	3·7	71	66·9	23·9	131	123·3	44·1	191	179·8	64·4	251	236·3	84·6
12	11·3	4·0	72	67·8	24·3	132	124·3	44·5	192	180·8	64·7	252	237·3	84·9
13	12·2	4·4	73	68·7	24·6	133	125·2	44·8	193	181·7	65·0	253	238·2	85·2
14	13·2	4·7	74	69·7	24·9	134	126·2	45·1	194	182·7	65·4	254	239·1	85·6
15	14·1	5·1	75	70·6	25·3	135	127·1	45·5	195	183·6	65·7	255	240·1	85·9
16	15·1	5·4	76	71·6	25·6	136	128·1	45·8	196	184·5	66·0	256	241·0	86·2
17	16·0	5·7	77	72·5	25·9	137	129·0	46·2	197	185·5	66·4	257	242·0	86·6
18	17·0	6·1	78	73·4	26·3	138	129·9	46·5	198	186·4	66·7	258	242·9	86·9
19	17·9	6·4	79	74·4	26·6	139	130·9	46·8	199	187·4	67·0	259	243·9	87·3
20	18·8	6·7	80	75·3	27·0	140	131·8	47·2	200	188·3	67·4	260	244·8	87·6
21	19·8	7·1	81	76·3	27·3	141	132·8	47·5	201	189·3	67·7	261	245·7	87·9
22	20·7	7·4	82	77·2	27·6	142	133·7	47·8	202	190·2	68·1	262	246·7	88·3
23	21·7	7·8	83	78·2	28·0	143	134·6	48·2	203	191·1	68·4	263	247·6	88·6
24	22·6	8·1	84	79·1	28·3	144	135·6	48·5	204	192·1	68·7	264	248·6	88·9
25	23·5	8·4	85	80·0	28·6	145	136·5	48·9	205	193·0	69·1	265	249·5	89·3
26	24·5	8·8	86	81·0	29·0	146	137·5	49·2	206	194·0	69·4	266	250·5	89·6
27	25·4	9·1	87	81·9	29·3	147	138·4	49·5	207	194·9	69·7	267	251·4	90·0
28	26·4	9·4	88	82·9	29·7	148	139·4	49·9	208	195·8	70·1	268	252·3	90·3
29	27·3	9·8	89	83·8	30·0	149	140·3	50·2	209	196·8	70·4	269	253·3	90·6
30	28·3	10·1	90	84·7	30·3	150	141·2	50·5	210	197·7	70·8	270	254·2	91·0
31	29·2	10·4	91	85·7	30·7	151	142·2	50·9	211	198·7	71·1	271	255·2	91·3
32	30·1	10·8	92	86·6	31·0	152	143·1	51·2	212	199·6	71·4	272	256·1	91·6
33	31·1	11·1	93	87·6	31·3	153	144·1	51·5	213	200·6	71·8	273	257·0	92·0
34	32·0	11·5	94	88·5	31·7	154	145·0	51·9	214	201·5	72·1	274	258·0	92·3
35	33·0	11·8	95	89·5	32·0	155	145·9	52·2	215	202·4	72·4	275	258·9	92·6
36	33·9	12·1	96	90·4	32·3	156	146·9	52·6	216	203·4	72·8	276	259·9	93·0
37	34·8	12·5	97	91·3	32·7	157	147·8	52·9	217	204·3	73·1	277	260·8	93·3
38	35·8	12·8	98	92·3	33·0	158	148·8	53·2	218	205·3	73·4	278	261·8	93·7
39	36·7	13·1	99	93·2	33·4	159	149·7	53·6	219	206·2	73·8	279	262·7	94·0
40	37·7	13·5	100	94·2	33·7	160	150·7	53·9	220	207·1	74·1	280	263·6	94·3
41	38·6	13·8	101	95·1	34·0	161	151·6	54·2	221	208·1	74·5	281	264·6	94·7
42	39·5	14·2	102	96·0	34·4	162	152·5	54·6	222	209·0	74·8	282	265·5	95·0
43	40·5	14·5	103	97·0	34·7	163	153·5	54·9	223	210·0	75·1	283	266·5	95·3
44	41·4	14·8	104	97·9	35·0	164	154·4	55·3	224	210·9	75·5	284	267·4	95·7
45	42·4	15·2	105	98·9	35·4	165	155·4	55·6	225	211·9	75·7	285	268·3	96·0
46	43·3	15·5	106	99·8	35·7	166	156·3	55·9	226	212·8	76·1	286	269·3	96·4
47	44·3	15·8	107	100·7	36·1	167	157·2	56·3	227	213·7	76·5	287	270·2	96·7
48	45·2	16·2	108	101·7	36·4	168	158·2	56·6	228	214·7	76·8	288	271·2	97·0
49	46·1	16·5	109	102·6	36·7	169	159·1	56·9	229	215·6	77·2	289	272·1	97·4
50	47·1	16·8	110	103·6	37·1	170	160·1	57·3	230	216·6	77·5	290	273·0	97·7
51	48·0	17·2	111	104·5	37·4	171	161·0	57·6	231	217·5	77·8	291	274·0	98·0
52	49·0	17·5	112	105·5	37·7	172	161·9	58·0	232	218·4	78·2	292	274·9	98·4
53	49·9	17·9	113	106·4	38·1	173	162·9	58·3	233	219·4	78·5	293	275·9	98·7
54	50·8	18·2	114	107·3	38·4	174	163·8	58·6	234	220·3	78·8	294	276·8	99·0
55	51·8	18·5	115	108·3	38·7	175	164·8	59·0	235	221·3	79·2	295	277·8	99·4
56	52·7	18·9	116	109·2	39·1	176	165·7	59·3	236	222·2	79.5	296	278·7	99·7
57	53·7	19·2	117	110·2	39·4	177	166·7	59·6	237	223·1	79·8	297	279·6	100·1
58	54·6	19·5	118	111·1	39·8	178	167·6	60·0	238	224·1	80·2	298	280·6	100·4
59	55·6	19·9	119	112·0	40·1	179	168·5	60·3	239	225·0	80·5	299	281·5	100·7
60	56·5	20·2	120	113·0	40·4	180	169·5	60·6	240	226·0	80·9	300	282·5	101·1
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

6¼ Points = 70° 19′

TABLE I.

Traverse Table to 2 Points = 22° 30′

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	0·9	0·4	61	56·4	23·3	121	111·8	46·3	181	167·2	69·3	241	222·7	92·2
2	1·9	0·6	62	57·3	23·7	122	112·7	46·7	182	168·2	69·7	242	223·6	92·6
3	2·8	1·2	63	58·2	24·1	123	113·6	47·1	183	169·1	70·0	243	224·5	93·0
4	3·7	1·5	64	59·1	24·5	124	114·6	47·5	184	170·0	70·4	244	225·4	93·4
5	4·6	1·9	65	60·1	24·9	125	115·5	47·8	185	170·9	70·8	245	226·4	93·8
6	5·5	2·3	66	61·0	25·3	126	116·4	48·2	186	171·8	71·2	246	227·3	94·1
7	6·5	2·7	67	61·9	25·6	127	117·3	48·6	187	172·8	71·6	247	228·2	94·5
8	7·4	3·1	68	62·8	26·0	128	118·3	49·0	188	173·7	71·9	248	229·1	94·9
9	8·3	3·4	69	63·8	26·4	129	119·2	49·4	189	174·6	72·3	249	230·1	95·3
10	9·2	3·8	70	64·7	26·8	130	120·1	49·8	190	175·5	72·7	250	231·0	95·6
11	10·2	4·2	71	65·6	27·2	131	121·0	50·1	191	176·5	73·1	251	231·9	96·1
12	11·1	4·6	72	66·5	27·6	132	122·0	50·5	192	177·4	73·5	252	232·8	96·4
13	12·0	5·0	73	67·4	27·9	133	122·9	50.9	193	178·2	73·9	253	233·7	96·8
14	12·9	5·4	74	68·4	28·3	134	123·8	51·3	194	179·2	74·2	254	234·7	97·2
15	13·9	5·7	75	69·3	28·7	135	124·7	51·7	195	180·2	74·6	255	235·6	97·6
16	14·8	6·1	76	70·2	29·1	136	125·7	52·0	196	181·1	75·0	256	236·5	98·0
17	15·7	6·5	77	71·1	29·5	137	126·6	52·4	197	182·0	75·4	257	237·4	98·4
18	16·6	6·9	78	72·1	29·9	138	127·5	52·8	198	182·9	75·8	258	238·4	98·7
19	17·6	7·3	79	73·0	30·2	139	128·4	53·2	199	183·9	76·2	259	239·3	99·1
20	18·5	7·7	80	73·9	30·6	140	129·3	53·6	200	184·8	76·5	260	240·2	99·5
21	19·4	8·0	81	74·8	31·0	141	130·3	54·0	201	185·7	76·9	261	241·1	99·9
22	20·3	8·4	82	75·8	31·4	142	131·2	54·3	202	186·6	77·3	262	242·1	100·3
23	21·3	8·8	83	76·7	31·8	143	132·1	54·7	203	187·6	77·7	263	243·0	100·6
24	22·2	9·2	84	77·6	32·2	144	133·0	55·1	204	188·5	78·1	264	243·9	101·0
25	23·1	9·6	85	78·5	32·5	145	134·0	55·5	205	189·4	78·5	265	244·8	101·4
26	24·0	10·0	86	79·5	32·9	146	134·9	55·9	206	190·3	78·8	266	245.8	101·8
27	24·9	10·3	87	80·4	33·3	147	135·8	56·3	207	191·2	79·2	267	246·7	102·2
28	25·9	10·7	88	81·3	33·7	148	136·7	56·6	208	192·2	79·6	268	247·6	102·6
29	26·8	11·1	89	82·2	34·1	149	137·7	57·0	209	193·1	80·0	269	248·5	102·9
30	27·7	11·5	90	83·2	34·4	150	138·6	57·4	210	194·0	80·4	270	249·5	103·3
31	28·6	11·9	91	84·1	34·8	151	139·5	57·8	211	194·9	80·8	271	250·4	103·7
32	29·6	12·3	92	85·0	35·2	152	140·4	58·2	212	195·9	81·1	272	251·3	104·1
33	30·5	12·6	93	85·9	35·6	153	141·4	58·6	213	196·8	81·5	273	252·2	104·5
34	31·4	13·0	94	86·9	36·0	154	142·3	58·9	214	197·7	81·9	274	253·1	104·9
35	32·3	13·4	95	87·8	36·4	155	143·2	59·3	215	198·6	82·3	275	254·1	105·2
36	33·3	13·8	96	88·7	36·7	156	144·1	59·7	216	199·6	82·7	276	255·0	105·6
37	34·2	14·2	97	89·6	37·1	157	145·1	60·1	217	200·5	83·0	277	255·9	106·0
38	35·1	14·5	98	90·5	37·5	158	146·0	60·5	218	201·4	83·4	278	256·8	106·4
39	36·0	14·9	99	91·5	37·9	159	146·9	60·9	219	202·3	83·8	279	257·8	106·8
40	37·0	15·3	100	92·4	38·3	160	147·8	61·2	220	203·3	84·2	280	258·7	107·2
41	37·9	15·7	101	93·3	38·7	161	148·7	61·6	221	204·2	84·6	281	259·6	107·5
42	38·8	16·1	102	94·2	39·0	162	149·7	62·0	222	205·1	85·0	282	260·5	107·9
43	39·7	16·5	103	95·2	39·4	163	150·6	62·4	223	206·0	85·3	283	261·5	108·3
44	40·6	16·8	104	96·1	39·8	164	151·5	62·8	224	207·0	85·7	284	262·4	108·7
45	41·6	17·2	105	97·0	40·2	165	152·4	63·1	225	207·9	86·1	285	263·3	109·1
46	42·5	17·6	106	97·9	40·6	166	153·4	63·5	226	208·8	86·5	286	264·2	109·5
47	43·4	18·0	107	98·8	41·0	167	154·3	63·9	227	209·7	86·9	287	265·2	109·8
48	44·4	18·4	108	99·8	41·3	168	155·2	64·3	228	210·6	87·3	288	266·1	110·2
49	45·3	18·8	109	100·7	41·7	169	156.1	64·7	229	211·6	87·6	289	267·0	110·6
50	46·2	19·1	110	101·6	42·1	170	157.1	65·1	230	212·5	88·0	290	267·9	111·0
51	47·1	19·5	111	102·6	42·5	171	158·0	65·4	231	213·4	88·4	291	268·9	111·4
52	48·0	19·9	112	103·5	42·9	172	158·9	65·8	232	214·3	88·8	292	269·8	111·7
53	49·0	20·3	113	104·4	43·2	173	159·8	66·2	233	215·3	89·2	293	270·7	112·1
54	49·9	20·7	114	105·3	43·6	174	160·8	66·6	234	216·2	89·6	294	271·6	112·5
55	50·8	21·1	115	106·3	44·0	175	161·7	67·0	235	217·1	89·9	295	272·5	112.9
56	51·7	21·4	116	107·2	44·4	176	162·6	67·4	236	218·0	90·3	296	273·5	113.3
57	52·7	21·8	117	108·1	44·8	177	163·5	67·7	237	219·0	90·7	297	274·4	113.7
58	53·6	22·2	118	109·0	45·2	178	164·5	68·1	238	219·9	91·1	298	275·3	114.0
59	54·5	22·6	119	109·9	45·5	179	165·4	68·5	239	220·8	91·5	299	276·2	114.4
60	55·4	23·0	120	110·9	45·9	180	166·3	68·9	240	221·7	91·8	300	277·2	114.8
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

6 Points = 67° 30′

Traverse Table to 2¼ Points = 25° 19′

Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
0·9	0·4	61	55·1	26·1	121	109·4	51·7	181	163·6	77·4	241	217·9	103·0
1·8	0·9	62	56·0	26·5	122	110·3	52·2	182	164·5	77·8	242	218·8	103·5
2·7	1·3	63	57·0	26·9	123	111·2	52·6	183	165·4	78·3	243	219·7	103·9
3·6	1·7	64	57·9	27·4	124	112·1	53·0	184	166·3	78·7	244	220·6	104·3
4·5	2·1	65	58·8	27·8	125	113·0	53·5	185	167·2	79·1	245	221·5	104·8
5·4	2·6	66	59·7	28·2	126	113·9	53·9	186	168·1	79·5	246	222·4	105·2
6·3	3·0	67	60·6	28·7	127	114·8	54·3	187	169·0	80·0	247	223·3	105·6
7·2	3·4	68	61·5	29·1	128	115·7	54·7	188	169·9	80·4	248	224·2	106·1
8·1	3·8	69	62·4	29·5	129	116·6	55·2	189	170·9	80·8	249	225·1	106·5
9·0	4·3	70	63·3	29·9	130	117·5	55·6	190	171·8	81·3	250	226·0	106·9
9·9	4·7	71	64·2	30·4	131	118·4	56·0	191	172·7	81·7	251	226·9	107·3
10·8	5·1	72	65·1	30·8	132	119·3	56·5	192	173·6	82·1	252	227·8	107·8
11·8	5·6	73	66·0	31·2	133	120·2	56·9	193	174·5	82·5	253	228·7	108·2
12·7	6·0	74	66·9	31·6	134	121·1	57·3	194	175·4	83·0	254	229·6	108·6
13·6	6·4	75	67·8	32·1	135	122·0	57·7	195	176·3	83·4	255	230·5	109·0
14·5	6·8	76	68·7	32·5	136	122·9	58·2	196	177·2	83·8	256	231·4	109·5
15·4	7·3	77	69·6	32·9	137	123·8	58·6	197	178·1	84·2	257	232·3	109·9
16·3	7·7	78	70·5	33·4	138	124·7	59·0	198	179·0	84·7	258	233·2	110·3
17·2	8·1	79	71·4	33·8	139	125·7	59·4	199	179·9	85·1	259	234·1	110·8
18·1	8·6	80	72·3	34·2	140	126·6	59·9	200	180·8	85·5	260	235·0	111·2
19·0	9·0	81	73·2	34·6	141	127·5	60·3	201	181·7	85·9	261	235·9	111·6
19·9	9·4	82	74·1	35·1	142	128·4	60·7	202	182·6	86·4	262	236·8	112·0
20·8	9·8	83	75·0	35·5	143	129·3	61·2	203	183·5	86·8	263	237·7	112·5
21·7	10·3	84	75·9	35·9	144	130·2	61·6	204	184·4	87·2	264	238·7	112·9
22·6	10·7	85	76·8	36·3	145	131·1	62·0	205	185·3	87·7	265	239·6	113·3
23·5	11·1	86	77·7	36·8	146	132·0	62·4	206	186·2	88·1	266	240·5	113·7
24·4	11·5	87	78·7	37·2	147	132·9	62·9	207	187·1	88·5	267	241·4	114·2
25·3	12·0	88	79·6	37·6	148	133·8	63·3	208	188·0	88·9	268	242·3	114·6
26·2	12·4	89	80·5	38·1	149	134·7	63·7	209	188·9	89·4	269	243·2	115·0
27·1	12·8	90	81·4	38·5	150	135·6	64·1	210	189·8	89·8	270	244·1	115·5
28·0	13·3	91	82·3	38·9	151	136·5	64·6	211	190·7	90·2	271	245·0	115·9
28·9	13·7	92	83·2	39·3	152	137·4	65·0	212	191·6	90·7	272	245·9	116·3
29·8	14·1	93	84·1	39·8	153	138·3	65·4	213	192·6	91·1	273	246·8	116·7
30·7	14·5	94	85·0	40·2	154	139·2	65·9	214	193·5	91·5	274	247·7	117·2
31·6	15·0	95	85·9	40·6	155	140·1	66·3	215	194·4	91·9	275	248·6	117·6
32·5	15·4	96	86·8	41·1	156	141·0	66·7	216	195·3	92·4	276	249·5	118·0
33·4	15·8	97	87·7	41·5	157	141·9	67·1	217	196·2	92·8	277	250·4	118·5
34·4	16·3	98	88·6	41·9	158	142·8	67·6	218	197·1	93·2	278	251·3	118·9
35·3	16·7	99	89·5	42·3	159	143·7	68·0	219	198·0	93·7	279	252·2	119·3
36·2	17·1	100	90·4	42·8	160	144·6	68·4	220	198·9	94·1	280	253·1	119·7
37·1	17·5	101	91·3	43·2	161	145·5	68·8	221	199·8	94·5	281	254·0	120·2
38·0	18·0	102	92·2	43·6	162	146·4	69·3	222	200·7	94·9	282	254·9	120·6
38·9	18·4	103	93·1	44·1	163	147·3	69·7	223	201·6	95·4	283	255·8	121·0
39·8	18·8	104	94·0	44·5	164	148·3	70·1	224	202·5	95·8	284	256·7	121·5
40·7	19·2	105	94·9	44·9	165	149·2	70·6	225	203·4	96·2	285	257·6	121·9
41·6	19·7	106	95·8	45·3	166	150·1	71·0	226	204·3	96·6	286	258·5	122·3
42·5	20·1	107	96·7	45·8	167	151·0	71·4	227	205·2	97·1	287	259·4	122·7
43·4	20·5	108	97·6	46·2	168	151.9	71·9	228	206·1	97·5	288	260·3	123·2
44·3	21·0	109	98·5	46·6	169	152·8	72·3	229	207·0	97·9	289	261·3	123·6
45·2	21·4	110	99·4	47·0	170	153·7	72·7	230	207·9	98·4	290	262·2	124·0
46·1	21·8	111	100·3	47·5	171	154·6	73·1	231	208·8	98·8	291	263·1	124·4
47·0	22·2	112	101·2	47·9	172	155·5	73·6	232	209·7	99·2	292	264·0	124·9
47·9	22·7	113	102·2	48·3	173	156·4	74·0	233	210·6	99·6	293	264·9	125·3
48·8	23·1	114	103·1	48·7	174	157·3	74·4	234	211·5	100·1	294	265·8	125·7
49·7	23·5	115	104·0	49·2	175	158·2	74·8	235	212·4	100·5	295	266·7	126·2
50·6	23·9	116	104·9	49·6	176	159·1	75·3	236	213·3	100·9	296	267·6	126·6
51·5	24·4	117	105·8	50·0	177	160·0	75·7	237	214·2	101·4	297	268·5	127·0
52·4	24·8	118	106·7	50·5	178	160·9	76·1	238	215·1	101·8	298	269·4	127·4
53·3	25·2	119	107·6	50·9	179	161·8	76·5	239	216·1	102·2	299	270·3	127·9
54·2	25·7	120	108·5	51·3	180	162·7	77·0	240	217·0	102·6	300	271·2	128·3
Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

5¾ Points = 64° 41′

TABLE I.

Traverse Table to 2½ Points = 28° 7′.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	0·9	0·5	61	53·8	28·8	121	106·7	57·0	181	159·6	85·3	241	212·5	113·6
2	1·8	0·9	62	54·7	29·2	122	107·6	57·5	182	160·5	85·8	242	213·4	114·1
3	2·6	1·4	63	55·6	29·7	123	108·5	58·0	183	161·4	86·3	243	214·3	114·6
4	3·5	1·9	64	56·4	30·2	124	109·4	58·4	184	162·3	86·7	244	215·2	115·0
5	4·4	2·4	65	57·3	30·6	125	110·2	58·9	185	163·2	87·2	245	216·1	115·5
6	5·3	2·8	66	58·2	31·1	126	111·1	59·4	186	164·0	87·7	246	217·0	116·0
7	6·2	3·3	67	59·1	31·6	127	112·0	59·9	187	164·9	88·1	247	217·8	116·4
8	7·1	3·8	68	60·0	32·1	128	112·9	60·3	188	165·8	88·6	248	218·7	116·9
9	7·9	4·2	69	60·9	32·5	129	113·8	60·8	189	166·7	89·1	249	219·6	117·4
10	8·8	4·7	70	61·7	33·0	130	114·7	61·3	190	167·6	89·6	250	220·5	117·8
11	9·7	5·2	71	62·6	33·5	131	115·5	61·7	191	168·5	90·0	251	221·4	118·3
12	10·6	5·7	72	63·5	33·9	132	116·4	62·2	192	169·3	90·5	252	222·2	118·8
13	11·5	6·1	73	64·4	34·4	133	117·3	62·7	193	170·2	91·0	253	223·1	119·3
14	12·3	6·6	74	65·3	34·9	134	118·2	63·2	194	171·1	91·4	254	224·0	119·7
15	13·2	7·1	75	66·1	35·4	135	119·1	63·6	195	172·0	91·9	255	224·9	120·2
16	14·1	7·5	76	67·0	35·8	136	119·9	64·1	196	172·9	92·4	256	225·8	120·7
17	15·0	8·0	77	67·9	36·3	137	120·8	64·6	197	173·7	92·9	257	226·7	121·1
18	15·9	8·5	78	68·8	36·8	138	121·7	65·0	198	174·6	93·3	258	227·5	121·6
19	16·8	9·0	79	69·7	37·2	139	122·6	65·5	199	175·5	93·8	259	228·4	122·1
20	17·6	9·4	80	70·6	37·7	140	123·5	66·0	200	176·4	94·3	260	229·3	122·6
21	18·5	9·9	81	71·4	38·2	141	124·4	66·5	201	177·3	94·7	261	230·2	123·0
22	19·4	10·4	82	72·3	38·6	142	125.2	66·9	202	178·2	95·2	262	231·1	123·5
23	20·3	10·8	83	73·2	39·1	143	126·1	67·4	203	179·0	95·7	263	231·9	124·0
24	21·2	11·3	84	74·1	39·6	144	127·0	67·9	204	179·9	96·2	264	232·8	124·4
25	22·1	11·8	85	75·0	40·1	145	127·9	68·3	205	180·8	96·6	265	233·7	124·9
26	22·9	12·3	86	75·9	40·5	146	128·8	68·8	206	181·7	97·1	266	234·6	125·4
27	23·8	12·7	87	76·7	41·0	147	129·6	69·3	207	182·6	97·6	267	235·5	125·9
28	24·7	13·2	88	77·6	41·5	148	130·5	69·8	208	183·4	98·0	268	236·4	126·3
29	25·6	13·7	89	78·5	41·9	149	131·4	70·2	209	184·3	98·5	269	237·2	126·8
30	26·5	14·1	90	79·4	42·4	150	132·3	70·7	210	185·2	99·0	270	238·1	127·3
31	27·3	14·6	91	80·3	42·9	151	133·2	71·2	211	186·1	99·5	271	239·0	127·7
32	28·2	15·1	92	81·1	43·4	152	134·1	71·6	212	187·0	99·9	272	239·9	128·2
33	29·1	15·6	93	82·0	43·8	153	134·9	72·1	213	187·8	100·4	273	240·8	128·7
34	30·0	16·0	94	82·9	44·3	154	135·8	72·6	214	188·7	100·9	274	241·7	129·2
35	30·9	16·5	95	83·8	44·8	155	136·7	73·1	215	189·6	101·3	275	242·5	129·6
36	31·7	17·0	96	84·7	45·2	156	137·6	73·5	216	190·5	101·8	276	243·4	130·1
37	32·6	17·4	97	85·6	45·7	157	138·5	74·0	217	191·4	102·3	277	244·3	130·6
38	33·5	17·9	98	86·4	46·2	158	139·3	74·5	218	192·3	102·8	278	245·2	131·0
39	34·4	18·4	99	87·3	46·7	159	140·2	74·9	219	193·1	103·2	279	246·1	131·5
40	35·3	18·9	100	88·2	47·1	160	141·1	75·4	220	194·0	103·7	280	246·9	132·0
41	36·2	19·3	101	89·1	47·6	161	142·0	75·9	221	194·9	104·2	281	247·8	132·5
42	37·0	19·8	102	90·0	48·1	162	142·9	76·4	222	195·8	104·6	282	248·7	132·9
43	37·9	20·3	103	90·8	48·5	163	143·8	76·8	223	196·7	105·1	283	249·6	133·4
44	38·8	20·7	104	91·7	49·0	164	144·6	77·3	224	197·6	105·6	284	250·5	133·9
45	39·7	21·2	105	92·6	49·5	165	145·5	77·8	225	198·4	106·1	285	251·4	134·3
46	40·6	21·7	106	93·5	50·0	166	146·4	78·2	226	199·3	106·5	286	252·2	134·8
47	41·5	22·2	107	94·4	50·4	167	147·3	78·7	227	200·2	107·0	287	253·1	135·3
48	42·3	22·6	108	95·3	50·9	168	148·2	79·2	228	201·1	107·5	288	254·0	135·8
49	43.2	23·1	109	96·1	51·4	169	149·0	79·7	229	202·0	107·9	289	254·9	136·2
50	44·1	23·6	110	97·0	51·8	170	149·9	80·1	230	202·8	108·4	290	255·8	136·7
51	45·0	24·0	111	97·9	52·3	171	150·8	80·6	231	203·7	108·9	291	256·6	137·2
52	45·9	24·5	112	98·8	52·8	172	151·7	81·1	232	204·6	109·4	292	257·5	137·6
53	46·7	25·0	113	99·7	53·3	173	152·6	81·5	233	205·5	109·8	293	258·4	138·1
54	47·6	25·5	114	100·5	53·7	174	153·5	82·0	234	206·4	110·3	294	259·3	138·6
55	48·5	25·9	115	101·4	54·2	175	154·3	82·5	235	207·3	110·8	295	260·2	139·1
56	49·4	26·4	116	102·3	54·7	176	155·2	83·0	236	208·1	111·2	296	261·1	139·5
57	50·3	26·9	117	103·2	55·1	177	156·1	83·4	237	209·0	111·7	297	261·9	140·0
58	51·2	27·3	118	104·1	55·6	178	157·0	83·9	238	209·9	112·2	298	262·8	140·5
59	52·0	27·8	119	105·0	56·1	179	157·9	84·4	239	210·8	112·7	299	263·7	140·9
60	52·9	28·3	120	105·8	56·6	180	158·8	84·8	240	211·7	113·1	300	264·6	141·4
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

5½ Points = 61° 52′

Traverse Table to 2¾ Points = 30° 56′

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	0·9	0·5	61	52·3	31·4	121	103·8	62·2	181	155·3	93·0	241	206·7	123·9
2	1·7	1·0	62	53·2	31·9	122	104·6	62·7	182	156·1	93·6	242	207·6	124·4
3	2·6	1·5	63	54·0	32·4	123	105·5	63·2	183	157·0	94·1	243	208·4	124·9
4	3·4	2·1	64	54·9	32·9	124	106·4	63·7	184	157·8	94·6	244	209·3	125·4
5	4·3	2·6	65	55·8	33·4	125	107·2	64·3	185	158·7	95·1	245	210·1	125·9
6	5·1	3·1	66	56·6	33·9	126	108·1	64·8	186	159·5	95·6	246	211·0	126·5
7	6·0	3·6	67	57·5	34·4	127	108·9	65·3	187	160·4	96·1	247	211·9	127·0
8	6·9	4·1	68	58·3	35·0	128	109·8	65·8	188	161·2	96·6	248	212·7	127·5
9	7·7	4·6	69	59·2	35·5	129	110·6	66·3	189	162·1	97·2	249	213·6	128·0
10	8·6	5·1	70	60·0	36·0	130	111·5	66·8	190	163·0	97·7	250	214·4	128·5
11	9·4	5·7	71	60·9	36·5	131	112·4	67·3	191	163·8	98·2	251	215·3	129·0
12	10·3	6·2	72	61·8	37·0	132	113·2	67·9	192	164·7	98·7	252	216·1	129·5
13	11·2	6·7	73	62·6	37·5	133	114·1	68·4	193	165·5	99·2	253	217·0	130·1
14	12·0	7·2	74	63·5	38·0	134	114·9	68·9	194	166·4	99·7	254	217·9	130·6
15	12·9	7·7	75	64·3	38·6	135	115·8	69·4	195	167·3	100·2	255	218·7	131·1
16	13·7	8·2	76	65·2	39·1	136	116·6	69·9	196	168·1	100·8	256	219·6	131·6
17	14·6	8·7	77	66·0	39·6	137	117·5	70·4	197	169·0	101·3	257	220·4	132·1
18	15·4	9·3	78	66·9	40·1	138	118·4	70·9	198	169·8	101·8	258	221·3	132·6
19	16·3	9·8	79	67·8	40·6	139	119·2	71·5	199	170·7	102·3	259	222·2	133·1
20	17·2	10·3	80	68·6	41·1	140	120·1	72·0	200	171·5	102·8	260	223·0	133·7
21	18·0	10·8	81	69·5	41·6	141	120·9	72·5	201	172·4	103·3	261	223·9	134·2
22	18·9	11·3	82	70·3	42·1	142	121·8	73·0	202	173·3	103·8	262	224·7	134·7
23	19·7	11·8	83	71·2	42·7	143	122·7	73·5	203	174·1	104·4	263	225·6	135·2
24	20·6	12·3	84	72·0	43·2	144	123·5	74·0	204	175·0	104·9	264	226·4	135·7
25	21·4	12·9	85	72·9	43·7	145	124·4	74·5	205	175·8	105·4	265	227·3	136·2
26	22·3	13·4	86	73·8	44·2	146	125·2	75·1	206	176·7	105·9	266	228·2	136·7
27	23·2	13·9	87	74·6	44·7	147	126·1	75·6	207	177·5	106·4	267	229·0	137·3
28	24·0	14·4	88	75·5	45·2	148	126·9	76·1	208	178·4	106·9	268	229·9	137·8
29	24·9	14·9	89	76·3	45·7	149	127·8	76·6	209	179·3	107·4	269	230·7	138·3
30	25·7	15·4	90	77·2	46·3	150	128·7	77·1	210	180·1	108·0	270	231·6	138·8
31	26·6	15·9	91	78·1	46·8	151	129·5	77·6	211	181·0	108·5	271	232·4	139·3
32	27·4	16·5	92	78·9	47·3	152	130·4	78·1	212	181·8	109·0	272	233·3	139·8
33	28·3	17·0	93	79·8	47·8	153	131·2	78·7	213	182·7	109·5	273	234·2	140·3
34	29·2	17·5	94	80·6	48·3	154	132·1	79·2	214	183·5	110·0	274	235·0	140·9
35	30·0	18·0	95	81·5	48·8	155	132·9	79·7	215	184·4	110·5	275	235·9	141·4
36	30·9	18·5	96	82·3	49·3	156	133·8	80·2	216	185·3	111·0	276	236·7	141·9
37	31·7	19·0	97	83. 2	49·9	157	134·7	80·7	217	186·1	111·6	277	237·6	142·4
38	32·6	19·5	98	84·1	50·4	158	135·5	81·2	218	187·0	112·1	278	238·4	142·9
39	33·5	20·1	99	84·9	50·9	159	136·4	81·7	219	187·8	112·6	279	239·3	143·4
40	34·3	20·6	100	85·8	51·4	160	137·2	82 3	220	188·7	113·1	280	240·2	143·9
41	35·2	21·1	101	86·6	51·9	161	138·1	82·8	221	189·6	113·6	281	241·0	144·5
42	36·0	21·6	102	87·5	52·4	162	138·9	83·3	222	190·4	114·1	282	241·9	145·0
43	36·9	22·1	103	88·3	52·9	163	139·8	83·8	223	191·3	114·6	283	242·7	145·5
44	37·7	22·6	104	89·2	53·5	164	140·7	84·3	224	192·1	115·2	284	243·6	146·0
45	38·6	23·1	105	90·1	54·0	165	141·5	84·8	225	193·0	115·7	285	244·4	146·5
46	39·5	23·6	106	90·9	54·5	166	142·4	85·3	226	193·8	116·2	286	245·3	147·0
47	40·3	24·2	107	91·8	55·0	167	143·2	85·8	227	194·7	116·7	287	246·2	147·5
48	41·2	24·7	108	92·6	55·5	168	144·1	86·4	228	195·6	117·2	288	247·0	148·1
49	42·0	25·2	109	93·5	56·0	169	145·0	86·9	229	196·4	117·7	289	247·9	148·6
50	42·9	25·7	110	94·3	56·5	170	145·8	87·4	230	197·3	118·2	290	248·7	149·1
51	43·7	26·2	111	95·2	57·1	171	146·7	87·9	231	198·1	118·8	291	249·6	149·6
52	44·6	26·7	112	96·1	57·6	172	147·5	88·4	232	199·0	119·3	292	250·5	150·1
53	45·5	27·2	113	96·9	58·1	173	148·4	88·9	233	199·8	119·8	293	251·3	150·6
54	46·3	27·8	114	97·8	58·6	174	149·2	89·4	234	200·7	120·3	294	252·2	151·1
55	47·2	28·3	115	98·6	59·1	175	150·1	90·0	235	201·6	120·8	295	253·0	151·7
56	48·0	28·8	116	99·5	59·6	176	151·0	90·5	236	202·4	121·3	296	253·9	152·2
57	48·9	29·3	117	100·4	60·1	177	151·8	91·0	237	203·3	121·8	297	254·7	152·7
58	49·7	29·8	118	101·2	60·7	178	152·7	91·5	238	204·1	122·4	298	255·6	153·2
59	50·6	30·3	119	102·1	61·2	179	153·5	92·0	239	205·0	122·9	299	256·5	153·7
60	51·5	30·8	120	102·9	61·7	180	154·4	92·5	240	205·9	123·4	300	257·3	154·2
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

5¼ Points = 59° 4′

TABLE I.

Traverse Table to 3 Points=33° 45′

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	0·8	0·6	61	50·7	33·9	121	100·6	67·2	181	150·5	100·6	241	200·4	133·9
2	1·7	1·1	62	51·5	34·4	122	101·4	67·8	182	151·3	101·1	242	201·2	134·4
3	2·5	1·7	63	52·4	35·0	123	102·3	68·3	183	152·2	101·7	243	202·0	135·0
4	3·3	2·2	64	53·2	35·6	124	103·1	68·9	184	153·0	102·2	244	202·9	135·6
5	4·2	2·8	65	54·0	36·1	125	103·9	69·4	185	153·8	102·8	245	203·7	136·1
6	5·0	3·3	66	54·9	36·7	126	104·8	70·0	186	154·6	103·3	246	204·5	136·7
7	5·8	3·9	67	55·7	37·2	127	105·6	70·6	187	155·5	103·9	247	205·4	137·2
8	6·7	4·4	68	56·5	37·8	128	106·4	71·1	188	156·3	104·4	248	206·2	137·8
9	7·5	5·0	69	57·4	38·3	129	107·3	71·7	189	157·1	105·0	249	207·0	138·3
10	8·3	5·6	70	58·2	38·9	130	108·1	72·2	190	158·0	105·6	250	207·9	138·9
11	9·1	6·1	71	59·0	39·4	131	108·9	72·8	191	158·8	106·1	251	208·7	139·4
12	10·0	6·7	72	59·9	40·0	132	109·7	73·3	192	159·6	106·7	252	209·5	140·0
13	10·8	7·2	73	60·7	40·6	133	110·6	73·9	193	160·5	107·2	253	210·4	140·6
14	11·6	7·8	74	61·5	41·1	134	111·4	74·4	194	161·3	107·8	254	211·2	141·1
15	12·5	8·3	75	62·4	41·7	135	112·2	75·0	195	162·1	108·3	255	212·0	141·7
16	13·3	8·9	76	63·2	42·2	136	113·1	75·6	196	163·0	108·9	256	212·9	142·2
17	14·1	9·4	77	64·0	42·8	137	113·9	76·1	197	163·8	109·4	257	213·7	142·8
18	15·0	10·0	78	64·8	43·3	138	114·7	76·7	198	164·6	110·0	258	214·5	143·3
19	15·8	10·6	79	65·7	43·9	139	115·6	77·2	199	165·5	110·6	259	215·3	143·9
20	16·6	11·1	80	66·5	44·4	140	116·4	77·8	200	166·3	111·1	260	216·2	144·4
21	17·5	11·7	81	67·3	45·0	141	117·2	78·3	201	167·1	111·7	261	217·0	145·0
22	18·3	12·2	82	68·2	45·6	142	118·1	78·9	202	168·0	112·2	262	217·8	145·6
23	19·1	12·8	83	69·0	46·1	143	118·9	79·4	203	168·8	112·8	263	218·7	146·1
24	20·0	13·3	84	69·8	46·7	144	119·7	80·0	204	169·6	113·3	264	219·5	146·7
25	20·8	13·9	85	70·7	47·2	145	120·6	80·6	205	170·4	113·9	265	220·3	147·2
26	21·6	14·4	86	71·5	47·8	146	121·4	81·1	206	171·3	114·4	266	221·2	147·8
27	22·4	15·0	87	72·3	48·3	147	122·2	81·7	207	172·1	115·0	267	222·0	148·3
28	23·3	15·6	88	73·2	48·9	148	123·1	82·2	208	172·9	115·6	268	222·8	148·9
29	24·1	16·1	89	74·0	49·4	149	123·9	82·8	209	173·8	116·1	269	223·7	149·4
30	24·9	16·7	90	74·8	50·0	150	124·7	83·3	210	174·6	116·7	270	224·5	150·0
31	25·8	17·2	91	75·7	50·6	151	125·5	83·9	211	175·4	117·2	271	225·3	150·6
32	26·6	17·8	92	76·5	51·1	152	126·4	84·4	212	176·3	117·8	272	226·2	151·1
33	27·4	18·3	93	77·3	51·7	153	127·2	85·0	213	177·1	118·3	273	227·0	151·7
34	28·3	18·9	94	78·2	52·2	154	128·0	85·6	214	177·9	118·9	274	227·8	152·2
35	29·1	19·4	95	79·0	52·8	155	128·9	86·1	215	178·8	119·4	275	228·6	152·8
36	29·9	20·0	96	79·8	53·3	156	129·7	86·7	216	179·6	120·0	276	229·5	153·3
37	30·8	20·6	97	80·6	53·9	157	130·5	87·2	217	180·4	120·6	277	230·3	153·9
38	31·6	21·1	98	81·5	54·4	158	131·4	87·8	218	181·3	121·1	278	231·1	154·4
39	32·4	21·7	99	82·3	55·0	159	132·2	88·3	219	182·1	121·7	279	232·0	155·0
40	33·3	22·2	100	83·1	55·6	160	133·0	88·9	220	182·9	122·2	280	232·8	155·6
41	34·1	22·8	101	84·0	56·1	161	133·9	89·4	221	183·7	122·8	281	233·6	156·1
42	34·9	23·3	102	84·8	56·7	162	134·7	90·0	222	184·6	123·3	282	234·5	156·7
43	35·8	23·9	103	85·6	57·2	163	135·5	90·6	223	185·4	123·9	283	235·3	157·2
44	36·6	24·4	104	86·5	57·8	164	136·4	91·1	224	186·2	124·4	284	236·1	157·8
45	37·4	25·0	105	87·3	58·3	165	137·2	91·7	225	187·1	125·0	285	237·0	158·3
46	38·2	25·6	106	88·1	58·9	166	138·0	92·2	226	187·9	125·6	286	237·8	158·9
47	39·1	26·1	107	89·0	59·4	167	138·9	92·8	227	188·7	126·1	287	238·6	159·4
48	39·9	26·7	108	89·8	60·0	168	139·7	93·3	228	189·6	126·7	288	239·5	160·0
49	40·7	27·2	109	90·6	60·6	169	140·5	93·9	229	190·4	127·2	289	240·3	160·6
50	41·6	27·8	110	91·5	61·1	170	141·3	94·4	230	191·2	127·8	290	241·1	161·1
51	42·4	28·3	111	92·3	61·7	171	142·2	95·0	231	192·1	128·3	291	242·0	161·7
52	43·2	28·9	112	93·1	62·2	172	143·0	95·6	232	192·9	128·9	292	242·8	162·2
53	44·1	29·4	113	94·0	62·8	173	143·8	96·1	233	193·7	129·4	293	243·6	162·8
54	44·9	30·0	114	94·8	63·3	174	144·7	96·7	234	194·6	130·0	294	244·4	163·3
55	45·7	30·6	115	95·6	63·9	175	145·5	97·2	235	195·4	130·6	295	245·3	163·9
56	46·6	31·1	116	96·4	64·4	176	146·3	97·8	236	196·2	131·1	296	246·1	164·4
57	47·4	31·7	117	97·3	65·0	177	147·2	98·3	237	197·1	131·7	297	246·9	165·0
58	48·2	32·2	118	98·1	65·6	178	148·0	98·9	238	197·9	132·2	298	247·8	165·6
59	49·1	32·8	119	98·9	66·1	179	148·8	99·4	239	198·7	132·8	299	248·6	166·1
60	49·9	33·3	120	99·8	66·7	180	149·7	100·0	240	199·5	133·3	300	249·4	166·7
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

5 Points = 56° 15′

TABLE I.

Traverse Table to 3¼ Points = 36° 34′

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	0·8	0·6	61	49·0	36·3	121	97·2	72·1	181	145·4	107·8	241	193·6	143·6
2	1·6	1·2	62	49·8	36·9	122	98·0	72·7	182	146·2	108·4	242	194·4	144·2
3	2·4	1·8	63	50·6	37·5	123	98·8	73·3	183	147·0	109·0	243	195·2	144·8
4	3·2	2·4	64	51·4	38·1	124	99·6	73·9	184	147·8	109·6	244	196·0	145·4
5	4·0	3·0	65	52·2	38·7	125	100·4	74·5	185	148·6	110·2	245	196·8	146·0
6	4·8	3·6	66	53·0	39·3	126	101·2	75·1	186	149·4	110·8	246	197·6	146·5
7	5·6	4·2	67	53·8	39·9	127	102·0	75·7	187	150·2	111·4	247	198·4	147·1
8	6·4	4·8	68	54·6	40·5	128	102·8	76·3	188	151·0	112·0	248	199·2	147·7
9	7·2	5·4	69	55·4	41·1	129	103·6	76·9	189	151·8	112·6	249	200·0	148·3
10	8·0	6·0	70	56·2	41·7	130	104·4	77·4	190	152·6	113·2	250	200·8	148·9
11	8·8	6·6	71	57·0	42·3	131	105·2	78·0	191	153·4	113·8	251	201·6	149·5
12	9·6	7·1	72	57·8	42·9	132	106·0	78·6	192	154·2	114·4	252	202·4	150·1
13	10·4	7·7	73	58·6	43·5	133	106·8	79·2	193	155·0	115·0	253	203·2	150·7
14	11·2	8·3	74	59·4	44·1	134	107·6	79·8	194	155·8	115·6	254	204·0	151·3
15	12·0	8·9	75	60·2	44·7	135	108·4	80·4	195	156·6	116·2	255	204·8	151·9
16	12·9	9·5	76	61·0	45·3	136	109·2	81·0	196	157·4	116·8	256	205·6	152·5
17	13·7	10·1	77	61·8	45·9	137	110·0	81·6	197	158·2	117·4	257	206·4	153·1
18	14·5	10·7	78	62·6	46·5	138	110·8	82·2	198	159·0	118·0	258	207·2	153·7
19	15·3	11·3	79	63·4	47·1	139	111·6	82·8	199	159·8	118·5	259	208·0	154·3
20	16·1	11·9	80	64·3	47·7	140	112·4	83·4	200	160·6	119·1	260	208·8	154·9
21	16·9	12·5	81	65·1	48·3	141	113·2	84·0	201	161·4	119·7	261	209·6	155·5
22	17·7	13·1	82	65·9	48·9	142	114·0	84·6	202	162·2	120·3	262	210·4	156·1
23	18·5	13·7	83	66·7	49·4	143	114·9	85·2	203	163·0	120·9	263	211·2	156·7
24	19·3	14·3	84	67·5	50·0	144	115·7	85·8	204	163·9	121·5	264	212·0	157·3
25	20·1	14·9	85	68·3	50·6	145	116·5	86·4	205	164·7	122·1	265	212·8	157·9
26	20·9	15·5	86	69·1	51·2	146	117·3	87·0	206	165·5	122·7	266	213·6	158·5
27	21·7	16·1	87	69·9	51·8	147	118·1	87·6	207	166·3	123·3	267	214·5	159·1
28	22·5	16·7	88	70·7	52·4	148	118·9	88·2	208	167·1	123·9	268	215·3	159·6
29	23·3	17·3	89	71·5	53·0	149	119·7	88·8	209	167·9	124·5	269	216·1	160·2
30	24·1	17·9	90	72·3	53·6	150	120·5	89·4	210	168·7	125·1	270	216·9	160·8
31	24·9	18·5	91	73·1	54·2	151	121·3	90·0	211	169·4	125·7	271	217·7	161·4
32	25·7	19·1	92	73·9	54·8	152	122·1	90·5	212	170·3	126·3	272	218·5	162·0
33	26·5	19·7	93	74·7	55·4	153	122·9	91·1	213	171·1	126·9	273	219·3	162·6
34	27·3	20·3	94	75·5	56·0	154	123·7	91·7	214	171·9	127·5	274	220·1	163·2
35	28·1	20·9	95	76·3	56·6	155	124·5	92·3	215	172·7	128·1	275	220·9	163·8
36	28·9	21·4	96	77·1	57·2	156	125·3	92·9	216	173·5	128·7	276	221·7	164·4
37	29·7	22·0	97	77·9	57·8	157	126·1	93·5	217	174·3	129·3	277	222·5	165·0
38	30·5	22·6	98	78·7	58·4	158	126·9	94·1	218	175·1	129·9	278	223·3	165·6
39	31·3	23·2	99	79·5	59·0	159	127·7	94·7	219	175·9	130·5	279	224·1	166·2
40	32·1	23·8	100	80·3	59·6	160	128·5	95·3	220	176·7	131·1	280	224·9	166·8
41	32·9	24·4	101	81·1	60·2	161	129·3	95·9	221	177·5	131·7	281	225·7	167·4
42	33·7	25·0	102	81·9	60·8	162	130·1	96·5	222	178·3	132·2	282	226·5	168·0
43	34·5	25·6	103	82·7	61·4	163	130·9	97·1	223	179·1	132·8	283	227·3	168·6
44	35·3	26·2	104	83·5	62·0	164	131·7	97·7	224	179·9	133·4	284	228·1	169·2
45	36·1	26·8	105	84·3	62·6	165	132·5	98·3	225	180·7	134·0	285	228·9	169·8
46	36·9	27·4	106	85·1	63·1	166	133·3	98·9	226	181·5	134·6	286	229·7	170·4
47	37·7	28·0	107	85·9	63·7	167	134·1	99·5	227	182·3	135·2	287	230·5	171·0
48	38·6	28·6	108	86·7	64·3	168	134·9	100·1	228	183·1	135·8	288	231·3	171·6
49	39·4	29·2	109	87·5	64·9	169	135·7	100·7	229	183·9	136·4	289	232·1	172·2
50	40·2	29·8	110	88·4	65·5	170	136·5	101·3	230	184·7	137·0	290	232·9	172·8
51	41·0	30·4	111	89·2	66·1	171	137·3	101·9	231	185·5	137·6	291	233·7	173·3
52	41·8	31·0	112	90·0	66·7	172	138·1	102·5	232	186·3	138·2	292	234·5	173·9
53	42·6	31·6	113	90·8	67·3	173	138·9	103·1	233	187·1	138·8	293	235·3	174·5
54	43·4	32·2	114	91·6	67·9	174	139·8	103·7	234	187·9	139·4	294	236·1	175·1
55	44·2	32·8	115	92·4	68·5	175	140·6	104·2	235	188·8	140·0	295	236·9	175·7
56	45·0	33·4	116	93·2	69·1	176	141·4	104·8	236	189·6	140·6	296	237·7	176·3
57	45·8	34·0	117	94·0	69·7	177	142·2	105·4	237	190·4	141·2	297	238·5	176·9
58	46·6	34·6	118	94·8	70·3	178	143·0	106·0	238	191·2	141·8	298	239·4	177·5
59	47·4	35·1	119	95·6	70·9	179	143·8	106·6	239	192·0	142·4	299	240·2	178·1
60	48·2	35·7	120	96·4	71·5	180	144·6	107·2	240	192·8	143·0	300	241·0	178·7
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

4¾ Points = 53° 26′

TABLE I.

Traverse Table to 3½ Points = 39° 22½′

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	0·8	0·6	61	47·1	38·7	121	93·5	76·8	181	139·9	114·8	241	186·3	152·9
2	1·5	1·3	62	47·9	39·3	122	94·3	77·4	182	140·7	115·5	242	187·1	153·5
3	2·3	1·9	63	48·7	40·0	123	95·1	78·0	183	141·5	116·1	243	187·8	154·2
4	3·1	2·5	64	49·5	40·6	124	95·8	78·7	184	142·2	116·7	244	188·6	154·8
5	3·9	3·2	65	50·2	41·2	125	96·6	79·3	185	143·0	117·4	245	189·4	155·4
6	4·6	3·8	66	51·0	41·9	126	97·4	79·9	186	143·8	118·0	246	190·2	156·1
7	5·4	4·4	67	51·8	42·5	127	98·2	80·6	187	144·5	118·6	247	190·9	156·7
8	6·2	5·1	68	52·6	43·1	128	98·9	81·2	188	145·3	119·3	248	191·7	157·3
9	7·0	5·7	69	53·3	43·8	129	99·7	81·8	189	146·1	119·9	249	192·5	158·0
10	7·7	6·3	70	54·1	44·4	130	100·5	82·5	190	146·9	120·5	250	193·2	158·6
11	8·5	7·0	71	54·9	45·0	131	101·3	83·1	191	147·6	121·2	251	194·0	159·2
12	9·3	7·6	72	55·7	45·7	132	102·0	83·7	192	148·4	121·8	252	194·8	159·9
13	10·0	8·2	73	56·4	46·3	133	102·8	84·4	193	149·2	122·4	253	195·6	160·5
14	10·8	8·9	74	57·2	46·9	134	103·6	85·0	194	150·0	123·1	254	196·3	161·1
15	11·6	9·5	75	58·0	47·6	135	104·4	85·6	195	150·7	123·7	255	197·1	161·8
16	12·4	10·1	76	58·7	48·2	136	105·1	86·3	196	151·5	124·3	256	197·9	162·4
17	13·1	10·8	77	59·5	48·8	137	105·9	86·9	197	152·3	125·0	257	198·7	163·0
18	13·9	11·4	78	60·3	49·5	138	106·7	87·5	198	153·1	125·6	258	199·4	163·7
19	14·7	12·0	79	61·1	50·1	139	107·4	88·2	199	153·8	126·2	259	200·2	164·3
20	15·5	12·7	80	61·8	50·7	140	108·2	88·8	200	154·6	126·9	260	201·0	164·9
21	16·2	13·3	81	62·6	51·4	141	109·0	89·4	201	155·4	127·5	261	201·8	165·6
22	17·0	14·0	82	63·4	52·0	142	109·8	90·1	202	156·1	128·1	262	202·5	166·2
23	17·8	14·6	83	64·2	52·7	143	110·5	90·7	203	156·9	128·8	263	203·3	166·8
24	18·6	15·2	84	64·9	53·3	144	111·3	91·3	204	157·7	129·4	264	204·1	167·5
25	19·3	15·9	85	65·7	53·9	145	112·1	92·0	205	158·5	130·0	265	204·8	168·1
26	20·1	16·5	86	66·5	54·6	146	112·9	92·6	206	159·2	130·7	266	205·6	168·7
27	20·9	17·1	87	67·2	55·2	147	113·6	93·3	207	160·0	131·3	267	206·4	169·4
28	21·6	17·8	88	68·0	55·8	148	114·4	93·9	208	160·8	132·0	268	207·2	170·0
29	22·4	18·4	89	68·8	56·5	149	115·2	94·5	209	161·6	132·6	269	207·9	170·6
30	23·2	19·0	90	69·6	57·1	150	115·9	95·2	210	162·3	133·2	270	208·7	171·3
31	24·0	19·7	91	70·3	57·7	151	116·7	95·8	211	163·1	133·9	271	209·5	171·9
32	24·7	20·3	92	71·1	58·4	152	117·5	96·4	212	163·9	134·5	272	210·3	172·6
33	25·5	20·9	93	71·9	59·0	153	118·3	97·1	213	164·6	135·1	273	211·0	173·2
34	26·3	21·6	94	72·7	59·6	154	119·0	97·7	214	165·4	135·8	274	211·8	173·8
35	27·1	22·2	95	73·4	60·3	155	119·8	98·3	215	166·2	136·4	275	212·6	174·5
36	27·8	22·8	96	74·2	60·9	156	120·6	99·0	216	167·0	137·0	276	213·3	175·1
37	28·6	23·5	97	75·0	61·5	157	121·4	99·6	217	167·7	137·7	277	214·1	175·7
38	29·4	24·1	98	75·7	62·2	158	122·1	100·2	218	168·5	138·3	278	214·9	176·4
39	30·1	24·7	99	76·5	62·8	159	122·9	100·9	219	169·3	138·9	279	215·7	177·0
40	30·9	25·4	100	77·3	63·4	160	123·7	101·5	220	170·1	139·6	280	216·4	177·6
41	31·7	26·0	101	78·1	64·1	161	124·4	102·1	221	170·8	140·2	281	217·2	178·3
42	32·5	26·6	102	78·8	64·7	162	125·2	102·8	222	171·6	140·8	282	218·0	178·9
43	33·2	27·3	103	79·6	65·3	163	126·0	103·4	223	172·4	141·5	283	218·8	179·5
44	34·0	27·9	104	80·4	66·0	164	126·8	104·0	224	173·1	142·1	284	219·5	180·2
45	34·8	28·5	105	81·2	66·6	165	127·5	104·7	225	173·9	142·7	285	220·3	180·8
46	35·6	29·2	106	81·9	67·2	166	128·3	105·3	226	174·7	143·4	286	221·1	181·4
47	36·3	29·8	107	82·7	67·9	167	129·1	105·9	227	175·5	144·0	287	221·8	182·1
48	37·1	30·4	108	83·5	68·5	168	129·9	106·6	228	176·2	144·6	288	222·6	182·7
49	37·9	31·1	109	84·3	69·1	169	130·6	107·2	229	177·0	145·3	289	223·4	183·3
50	38·6	31·7	110	85·0	69·8	170	131·4	107·8	230	177·8	145·9	290	224·2	184·0
51	39·4	32·3	111	85·8	70·4	171	132·2	108·5	231	178·6	146·5	291	224·9	184·6
52	40·2	33·0	112	86·6	71·0	172	133·0	109·1	232	179·3	147·2	292	225·7	185·2
53	41·0	33·6	113	87·3	71·7	173	133·7	109·7	233	180·1	147·8	293	226·5	185·9
54	41·7	34·3	114	88·1	72·3	174	134·5	110·4	234	180·9	148·4	294	227·3	186·5
55	42·5	34·9	115	88·9	73·0	175	135·3	111·0	235	181·7	149·1	295	228·0	187·1
56	43·3	35·5	116	89·7	73·6	176	136·0	111·6	236	182·4	149·7	296	228·8	187·8
57	44·1	36·2	117	90·4	74·2	177	136·8	112·3	237	183·2	150·3	297	229·6	188·4
58	44·8	36·8	118	91·2	74·9	178	137·6	112·9	238	184·0	151·0	298	230·4	189·0
59	45·6	37·4	119	92·0	75·5	179	138·4	113·6	239	184·7	151·6	299	231·1	189·7
60	46·4	38·1	120	92·8	76·1	180	139·1	114·2	240	185·5	152·3	300	231·9	190·3
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

4½ Points = 50° 37½′

TABLE I.

Traverse Table to 3¾ Points = 42° 11′

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	0·7	0·7	61	45·2	41·0	121	89·6	81·3	181	134·1	121·5	241	178·6	161·8
2	1·5	1·3	62	45·9	41·6	122	90·4	81·9	182	134·8	122·2	242	179·3	162·5
3	2·2	2·0	63	46·7	42·3	123	91·1	82·6	183	135·6	122·9	243	180·0	163·2
4	3·0	2·7	64	47·4	43·0	124	91·9	83·3	184	136·3	123·6	244	180·8	163·8
5	3·7	3·4	65	48·2	43·6	125	92·6	83·9	185	137·1	124·2	245	181·5	164·5
6	4·4	4.0	66	48·9	44·3	126	93·4	84·6	186	137·8	124·9	246	182·3	165·2
7	5·2	4·7	67	49·6	45·0	127	94·1	85·3	187	138·6	125·6	247	183·0	165·9
8	5·9	5·4	68	50·4	45·7	128	94·8	86·0	188	139·3	126·2	248	183·8	166·5
9	6·7	6·0	69	51·1	46·3	129	95·6	86·6	189	140·0	126·9	249	184·5	167·2
10	7·4	6·7	70	51·9	47·0	130	96·3	87·3	190	140·8	127·6	250	185·2	167·9
11	8·2	7·4	71	52·6	47·7	131	97·1	88·0	191	141·5	128·3	251	186·0	168·5
12	8·9	8·1	72	53·3	48·3	132	97·8	88·6	192	142·3	128·9	252	186·7	169·2
13	9·6	8·7	73	54·1	49·0	133	98·5	89·3	193	143·0	129·6	253	187·5	169·9
14	10·4	9·4	74	54·8	49·7	134	99·3	90·0	194	143·7	130·3	254	188·2	170·6
15	11·1	10·1	75	55·6	50·4	135	100·0	90·7	195	144·5	130·9	255	188·9	171·2
16	11·9	10·7	76	56·3	51·0	136	100·8	91·3	196	145·2	131·6	256	189·7	171·9
17	12·6	11·4	77	57·0	51.7	137	101·5	92·0	197	146·0	132·3	257	190·4	172·6
18	13·3	12·1	78	57·8	52·4	138	102·2	92·7	198	146·7	133·0	258	191·2	173·2
19	14·1	12·8	79	58·5	53·0	139	103·0	93·3	199	147·4	133·6	259	191·9	173·9
20	14·8	13·4	80	59·3	53·7	140	103·7	94·0	200	148·2	134·3	260	192·6	174·6
21	15·6	14·1	81	60·0	54·4	141	104·5	94·7	201	148·9	135·0	261	193·4	175·3
22	16·3	14·8	82	60·8	55·1	142	105·2	95·4	202	149·7	135·6	262	194·1	175·9
23	17·0	15·4	83	61·5	55·7	143	106·0	96·0	203	150·4	136·3	263	194·9	176·6
24	17·8	16·1	84	62·2	56·4	144	106·7	96·7	204	151·1	137·0	264	195·6	177·3
25	18·5	16·8	85	63·0	57·1	145	107·4	97·4	205	151·9	137·7	265	196·3	178·0
26	19·3	17·5	86	63·7	57·7	146	108·2	98·0	206	152·6	138·3	266	197·1	178·6
27	20·0	18·1	87	64·5	58·4	147	108·9	98·7	207	153·4	139·0	267	197·8	179·3
28	20·7	18·8	88	65·2	59·1	148	109·7	99·4	208	154·1	139·7	268	198·6	180·0
29	21·5	19·5	89	65·9	59·8	149	110·4	100·1	209	154·9	140·3	269	199·3	180·6
30	22·2	20·1	90	66·7	60·4	150	111·1	100·7	210	155·6	141·0	270	200·1	181·3
31	23·0	20·8	91	67·4	61·1	151	111·9	101·4	211	156·3	141·7	271	200·8	182·0
32	23·7	21·5	92	68·2	61·8	152	112·6	102·1	212	157·1	142·4	272	201·5	182·7
33	24·4	22·2	93	68·9	62·4	153	113·4	102·7	213	157·8	143·0	273	202·3	183·3
34	25·2	22·8	94	69·6	63·1	154	114·1	103·4	214	158·6	143·7	274	203·0	184·0
35	25·9	23·5	95	70·4	63·8	155	114·8	194·1	215	159·3	144·4	275	203·8	184·7
36	26·7	24·2	96	71·1	64·5	156	115·6	104·8	216	160·0	145·0	276	204·5	185·3
37	27·4	24·8	97	71·9	65·1	157	116·3	105·4	217	160·8	145·7	277	205·2	186·0
38	28·2	25·5	98	72·6	65·8	158	117·1	106·1	218	161·5	146·4	278	206·0	186·7
39	28·9	26·2	99	73·3	66·5	159	117·8	106·8	219	162·3	147·1	279	206·7	187·4
40	29·6	26·9	100	74·1	67·2	160	118·5	107·4	220	163·0	147·7	280	207·5	188·0
41	30·4	27·5	101	74·8	67·8	161	119·3	108·1	221	163·6	148·4	281	208·2	188·7
42	31·1	28·2	102	75·6	68·5	162	120·0	108·8	222	164·5	149·1	282	208·9	189·4
43	31.9	28·9	103	76·3	69·2	163	120·8	109·5	223	165·2	149·7	283	209·7	190·0
44	32.6	29·5	104	77·1	69·8	164	121·5	110·1	224	166·0	150·4	284	210·4	190·7
45	33·3	30·2	105	77·8	70·5	165	122·3	110·8	225	166·7	151·1	285	211·2	191·4
46	34·1	30·9	106	78·5	71·2	166	123·0	111·5	226	167·4	151·8	286	211·9	192·1
47	34·8	31·6	107	79·3	71·8	167	123·7	112·1	227	168·2	152·4	287	212·6	192·7
48	35·6	32·2	108	80·0	72·5	168	124·5	112·8	228	168·9	153·1	288	213·4	193·4
49	36·3	32·9	109	80·8	73·2	169	125·2	113·5	229	169·7	153·8	289	214·1	194·1
50	37·0	33·6	110	81·5	73·9	170	126·0	114·2	230	170·4	154·5	290	214·9	194·7
51	37·8	34·2	111	82·2	74·5	171	126·7	114·8	231	171·2	155·1	291	215·6	195·4
52	38·5	34·9	112	83·0	75·2	172	127·4	115·5	232	171·9	155·8	292	216·4	196·1
53	39·3	35·6	113	83·7	75·9	173	128·2	116·2	233	172·6	156·5	293	217·1	196·8
54	40·0	36·3	114	84·5	76·5	174	128·9	116·8	234	173·4	157·1	294	217·8	197·4
55	40·7	36·9	115	85·2	77·2	175	129·7	117·5	235	174·1	157·8	295	218·6	198·1
56	41·5	37·6	116	85·9	77·9	176	130·4	118·2	236	174·9	158·5	296	219·3	198·8
57	42·2	38·3	117	86·7	78·6	177	131·1	118·9	237	175·6	159·1	297	220·1	199·4
58	43·0	39·0	118	87·4	79·2	178	131·9	119·5	238	176·3	159·8	298	220·8	200·1
59	43·7	39·6	119	88·2	79·9	179	132·6	120·2	239	177·1	160·5	299	221·5	200·8
60	44·5	40·3	120	88·9	80·6	180	133·4	120·9	240	177·8	161·2	300	222·3	201·5
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

4¼ Points = 47° 49′

TABLE I.

Traverse Table to 4 Points = 45° 0′

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	0·7	0·7	61	43·1	43·1	121	85·6	85·6	181	128·0	128·0	241	170·4	170·4
2	1·4	1·4	62	43·8	43·8	122	86·3	86·3	182	128·7	128·7	242	171·1	171·1
3	2·1	2·1	63	44·5	44·5	123	87·0	87·0	183	129·4	129·4	243	171·8	171·8
4	2·8	2·8	64	45·3	45·3	124	87·7	87·7	184	130·1	130·1	244	172·5	172·5
5	3·5	3·5	65	46·0	46·0	125	88·4	88·4	185	130·8	130·8	245	173·2	173·2
6	4·2	4·2	66	46·7	46·7	126	89·1	89·1	186	131·5	131·5	246	173·9	173·9
7	4·9	4·9	67	47·4	47·4	127	89·8	89·8	187	132·2	132·2	247	174·7	174·7
8	5·7	5·7	68	48·1	48·1	128	90·5	90·5	188	132·9	132·9	248	175·4	175·4
9	6·4	6·4	69	48·8	48·8	129	91·2	91·2	189	133·6	133·6	249	176·1	176·1
10	7·1	7·1	70	49·5	49·5	130	91·9	91·9	190	134·3	134·3	250	176·8	176·8
11	7·8	7·8	71	50·2	50·2	131	92·6	92·6	191	135·1	135·1	251	177·5	177·5
12	8·5	8·5	72	50·9	50·9	132	93·3	93·3	192	135·8	135·8	252	178·2	178·2
13	9·2	9·2	73	51·6	51·6	133	94·0	94·0	193	136·5	136·5	253	178·9	178·9
14	9·9	9·9	74	52·3	52·3	134	94·8	94·8	194	137·2	137·2	254	179·6	179·6
15	10·6	10·6	75	53·0	53·0	135	95·5	95·5	195	137·9	137·9	255	180·3	180·3
16	11·3	11·3	76	53·7	53·7	136	96·2	96·2	196	138·6	138·6	256	181·0	181·0
17	12·0	12·0	77	54·4	54·4	137	96·9	96·9	197	139·3	139·3	257	181·7	181·7
18	12·7	12·7	78	55·2	55·2	138	97·6	97·6	198	140·0	140·0	258	182·4	182·4
19	13·4	13·4	79	55·9	55·9	139	98·3	98·3	199	140·7	140·7	259	183·1	183·1
20	14·1	14·1	80	56·6	56·6	140	99·0	99·0	200	141·4	141·4	260	183·8	183·8
21	14·8	14·8	81	57·3	57·3	141	99·7	99·7	201	142·1	142·1	261	184·6	184·6
22	15·6	15·6	82	58·0	58·0	142	100·4	100·4	202	142·8	142·8	262	185·3	185·3
23	16·3	16·3	83	58·7	58·7	143	101·1	101·1	203	143·5	143·5	263	186·0	186·0
24	17·0	17·0	84	59·4	59·4	144	101·8	101·8	204	144·2	144·2	264	186·7	186·7
25	17·7	17·7	85	60·1	60·1	145	102·5	102·5	205	145·0	145·0	265	187·4	187·4
26	18·4	18·4	86	60·8	60·8	146	103·2	103·2	206	145·7	145·7	266	188·1	188·1
27	19·1	19·1	87	61·5	61·5	147	103·9	103·9	207	146·4	146·4	267	188·8	188·8
28	19·8	19·8	88	62·2	62·2	148	104·7	104·7	208	147·1	147·1	268	189·5	189·5
29	20·5	20·5	89	62·9	62·9	149	105·4	105·4	209	147·8	147·8	269	190·2	190·2
30	21·2	21·2	90	63·6	63·6	150	106·1	106·1	210	148·5	148·5	270	190·9	190·9
31	21·9	21·9	91	64·3	64·3	151	106·8	106·8	211	149·2	149·2	271	191·6	191·6
32	22·6	22·6	92	65·1	65·1	152	107·5	107·5	212	149·9	149·9	272	192·3	192·3
33	23·3	23·3	93	65·8	65·8	153	108·2	108·2	213	150·6	150·6	273	193·0	193·0
34	24·0	24·0	94	66·5	66·5	154	108·9	108·9	214	151·3	151·3	274	193·7	193·7
35	24·7	24·7	95	67·2	67·2	155	109·6	109·6	215	152·0	152·0	275	194·5	194·5
36	25·5	25·5	96	67·9	67·9	156	110·3	110·3	216	152·7	152·7	276	195·2	195·2
37	26·2	26·2	97	68·6	68·6	157	111·0	111·0	217	153·4	153·4	277	195·9	195·9
38	26·9	26·9	98	69·3	69·3	158	111·7	111·7	218	154·1	154·1	278	196·6	196·6
39	27·6	27·6	99	70·0	70·0	159	112·4	112·4	219	154·9	154·9	279	197·3	197·3
40	28·3	28·3	100	70·7	70·7	160	113·1	113·1	220	155·6	155·6	280	198·0	198·0
41	29·0	29·0	101	71·4	71·4	161	113·8	113·8	221	156·3	156·3	281	198·7	198·7
42	29·7	29·7	102	72·1	72·1	162	114·5	114·5	222	157·0	157·0	282	199·4	199·4
43	30·4	30·4	103	72·8	72·8	163	115·3	115·3	223	157·7	157·7	283	200·1	200·1
44	31·1	31·1	104	73·5	73·5	164	116·0	116·0	224	158·4	158·4	284	200·8	200·8
45	31·8	31·8	105	74·2	74·2	165	116·7	116·7	225	159·1	159·1	285	201·5	201·5
46	32·5	32·5	106	75·0	75·0	166	117·4	117·4	226	159·8	159·8	286	202·2	202·2
47	33·2	33·2	107	75·7	75·7	167	118·1	118·1	227	160·5	160·5	287	202·9	202·9
48	33·9	33·9	108	76·4	76·4	168	118·8	118·8	228	161·2	161·2	288	203·6	203·6
49	34·6	34·6	109	77·1	77·1	169	119·5	119·5	229	161·9	161·9	289	204·3	204·3
50	35·4	35·4	110	77·8	77·8	170	120·2	120·2	230	162·6	162·6	290	205·1	205·1
51	36·1	36·1	111	78·5	78·5	171	120·9	120·9	231	163·3	163·3	291	205·8	205·8
52	36·8	36·8	112	79·2	79·2	172	121·6	121·6	232	164·0	164·0	292	206·5	206·5
53	37·5	37·5	113	79·9	79·9	173	122·3	122·3	233	164·8	164·8	293	207·2	207·2
54	38·2	38·2	114	80·6	80·6	174	123·0	123·0	234	165·5	165·5	294	207·9	207·9
55	38·9	38·9	115	81·3	81·3	175	123·7	123·7	235	166·2	166·2	295	208·6	208·6
56	39·6	39·6	116	82·0	82.0	176	124·4	124·4	236	166·9	166·9	296	209·3	209·3
57	40·3	40·3	117	82·7	82·7	177	125·2	125·2	237	167·6	167·6	297	210.0	210·0
58	41·0	41·0	118	83·4	83·4	178	125·9	125·9	238	168·3	168·3	298	210·7	210·7
59	41·7	41·7	119	84·1	84·1	179	126·6	126·6	239	169·0	169·0	299	211·4	211·4
60	42·4	42·4	120	84·8	84·8	180	127·3	127·3	240	169·7	169·7	300	212·1	212·1
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

4 Points = 45° 0′

TABLE 2.

Traverse Table to 1 Degree = 0h. 4m.

Dist	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	1·0	0·0	61	61·0	1·1	121	121·0	2·1	181	181·0	3.2	241	241·0	4·2
2	2·0	0·0	62	62·0	1.1	122	122·0	2·1	182	182·0	3·2	242	242·0	4·2
3	3·0	0·1	63	63·0	1·1	123	123·0	2·1	183	183·0	3·2	243	243·0	4·2
4	4·0	0·1	64	64·0	1·1	124	124·0	2·2	184	184·0	3·2	244	244·0	4·3
5	5·0	0·1	65	65·0	1·1	125	125·0	2·2	185	185·0	3·2	245	245·0	4·3
6	6·0	0·1	66	66·0	1·2	126	126·0	2·2	186	186·0	3·2	246	246·0	4·3
7	7·0	0·1	67	67·0	1·2	127	127·0	2·2	187	187·0	3·3	247	247·0	4·3
8	8·0	0·1	68	68·0	1·2	128	128·0	2·2	188	188·0	3·3	248	248·0	4·3
9	9·0	0·2	69	69·0	1·2	129	129·0	2·3	189	189·0	3·3	249	249·0	4·3
10	10·0	0·2	70	70·0	1·2	130	130·0	2·3	190	190·0	3·3	250	250·0	4·4
11	11·0	0·2	71	71·0	1·2	131	131·0	2·3	191	191·0	3·3	251	251·0	4·4
12	12·0	0·2	72	72·0	1·3	132	132·0	2·3	192	192·0	3·4	252	252·0	4·4
13	13·0	0·2	73	73·0	1·3	133	133·0	2·3	193	193·0	3·4	253	253·0	4·4
14	14·0	0·2	74	74·0	1·3	134	134·0	2·3	194	194·0	3·4	254	254·0	4·4
15	15·0	0·3	75	75·0	1·3	135	135·0	2·4	195	195·0	3·4	255	255·0	4·5
16	16·0	0·3	76	76·0	1·3	136	136·0	2·4	196	196·0	3·4	256	256·0	4·5
17	17·0	0·3	77	77·0	1·3	137	137·0	2·4	197	197·0	3·4	257	257·0	4·5
18	18·0	0·3	78	78·0	1·4	138	138·0	2·4	198	198·0	3·5	258	258·0	4·5
19	19·0	0·3	79	79·0	1·4	139	139·0	2·4	199	199·0	3·5	259	259·0	4·5
20	20·0	0·3	80	80·0	1·4	140	140·0	2·4	200	200·0	3·5	260	260·0	4·5
21	21·0	0·4	81	81·0	1·4	141	141·0	2·5	201	201·0	3·5	261	261·0	4·6
22	22·0	0·4	82	82·0	1·4	142	142·0	2·5	202	202·0	3·5	262	262·0	4·6
23	23·0	0·4	83	83·0	1·4	143	143·0	2·5	203	203·0	3·5	263	263.0	4·6
24	24·0	0·4	84	84·0	1·5	144	144·0	2·5	204	204·0	3·6	264	264·0	4·6
25	25·0	0·4	85	85·0	1·5	145	145·0	2·5	205	205·0	3·6	265	265·0	4·6
26	26·0	0·5	86	86·0	1·5	146	146·0	2·5	206	206·0	3·6	266	266·0	4·6
27	27·0	0·5	87	87·0	1·5	147	147·0	2·6	207	207·0	3·6	267	267·0	4·7
28	28·0	0·5	88	88·0	1·5	148	148·0	2·6	208	208·0	3·6	268	268·0	4·7
29	29·0	0·5	89	89·0	1·6	149	149·0	2·6	209	209·0	3·6	269	269·0	4·7
30	30·0	0·5	90	90·0	1·6	150	150·0	2·6	210	210·0	3·7	270	270·0	4·7
31	31·0	0·5	91	91·0	1·6	151	151·0	2·6	211	211·0	3·7	271	271·0	4·7
32	32·0	0·6	92	92·0	1·6	152	152·0	2·7	212	212·0	3·7	272	272·0	4·7
33	33·0	0·6	93	93·0	1·6	153	153·0	2·7	213	213·0	3·7	273	273·0	4·8
34	34·0	0·6	94	94·0	1·6	154	154·0	2·7	214	214·0	3·7	274	274·0	4·8
35	35·0	0·6	95	95·0	1·7	155	155·0	2·7	215	215·0	3·8	275	275·0	4·8
36	36·0	0·6	96	96·0	1·7	156	156·0	2·7	216	216·0	3·8	276	276·0	4·8
37	37·0	0·6	97	97·0	1·7	157	157·0	2·7	217	217·0	3·8	277	277·0	4·8
38	38·0	0·7	98	98·0	1·7	158	158·0	2·8	218	218·0	3·8	278	278·0	4·9
39	39·0	0·7	99	99·0	1·7	159	159·0	2·8	219	219·0	3·8	279	279·0	4·9
40	40·0	0·7	100	100·0	1·7	160	160·0	2·8	220	220·0	3·8	280	280·0	4·9
41	41·0	0·7	101	101·0	1·8	161	161·0	2·8	221	221·0	3·9	281	281·0	4·9
42	42·0	0·7	102	102·0	1·8	162	162·0	2·8	222	222·0	3·9	282	282·0	4·9
43	43·0	0·8	103	103·0	1·8	163	163·0	2·8	223	223·0	3·9	283	283·0	4·9
44	44·0	0·8	104	104·0	1·8	164	164·0	2·9	224	224·0	3·9	284	284·0	5·0
45	45·0	0·8	105	105·0	1·8	165	165·0	2·9	225	225·0	3·9	285	285·0	5·0
46	46·0	0·8	106	106·0	1·8	166	166·0	2·9	226	226·0	3·9	286	286·0	5·0
47	47·0	0·8	107	107·0	1·9	167	167·0	2·9	227	227·0	4·0	287	287·0	5·0
48	48·0	0·8	108	108·0	1·9	168	168·0	2·9	228	228·0	4·0	288	288·0	5·0
49	49·0	0·9	109	109·0	1·9	169	169·0	2·9	229	229·0	4·0	289	289·0	5·0
50	50·0	0·9	110	110·0	1·9	170	170·0	3·0	230	230·0	4·0	290	290·0	5·1
51	51·0	0·9	111	111·0	1·9	171	171.0	3·0	231	231·0	4·0	291	291·0	5·1
52	52·0	0·9	112	112·0	2·0	172	172·0	3·0	232	232·0	4·0	292	292·0	5·1
53	53·0	0·9	113	113·0	2·0	173	173·0	3·0	233	233·0	4·1	293	293·0	5·1
54	54.0	0·9	114	114·0	2·0	174	174·0	3·0	234	234·0	4·1	294	294·0	5·1
55	55·0	1·0	115	115·0	2·0	175	175·0	3·1	235	235·0	4·1	295	295·0	5·1
56	56·0	1·0	116	116·0	2·0	176	176·0	3·1	236	236·0	4·1	296	296·0	5·2
57	57·0	1·0	117	117·0	2·0	177	177·0	3·1	237	237·0	4·1	297	297·0	5·2
58	58·0	1·0	118	118·0	2·1	178	178·0	3·1	238	238·0	4·2	298	298·0	5·2
59	59·0	1·0	119	119·0	2·1	179	179·0	3·1	239	239·0	4·2	299	299·0	5·2
60	60·0	1·0	120	120·0	2·1	180	180·0	3·1	240	240·0	4·2	300	300·0	5·2
Dist	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

89° = 5 h. 56 m.

TABLE 2.

Traverse Table to 2 Degrees = 0h. 8m.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	1·0	0·0	61	61·0	2·1	121	120·9	4·2	181	180·9	6·3	241	240·9	8·4
2	2·0	0·1	62	62·0	2·2	122	121·9	4·3	182	181·9	6·4	242	241·9	8·4
3	3·0	0·1	63	63·0	2·2	123	122·9	4·3	183	182·9	6·4	243	242·9	8·5
4	4·0	0·1	64	64·0	2·2	124	123·9	4·3	184	183·9	6·4	244	243·9	8·5
5	5·0	0·2	65	65·0	2·3	125	124·9	4·4	185	184·9	6·5	245	244·9	8·6
6	6·0	0·2	66	66·0	2·3	126	125·9	4·4	186	185·9	6·5	246	245·8	8·6
7	7·0	0·2	67	67.0	2·3	127	126·9	4·4	187	186·9	6·5	247	246·8	8·6
8	8·0	0·3	68	68·0	2·4	128	127·9	4·5	188	187·9	6·6	248	247·8	8·7
9	9·0	0·3	69	69·0	2·4	129	128·9	4·5	189	188·9	6·6	249	248·8	8·7
10	10·0	0·3	70	70·0	2·4	130	129·9	4·5	190	189·9	6·6	250	249·8	8·7
11	11·0	0·4	71	71·0	2·5	131	130·9	4·6	191	190·9	6·7	251	250·8	8·8
12	12·0	0·4	72	72·0	2·5	132	131·9	4·6	192	191·9	6·7	252	251·8	8·8
13	13·0	0·5	73	73·0	2·5	133	132·9	4·6	193	192·9	6·7	253	252·8	8·8
14	14·0	0·5	74	74·0	2·6	134	133·9	4·7	194	193·9	6·8	254	253·8	8·9
15	15·0	0·5	75	75·0	2·6	135	134·9	4·7	195	194·9	6·8	255	254·8	8·9
16	16·0	0·6	76	76·0	2·7	136	135·9	4·7	196	195·9	6·8	256	255·8	8·9
17	17·0	0·6	77	77·0	2·7	137	136·9	4·8	197	196·9	6·9	257	256·8	9·0
18	18·0	0·6	78	78·0	2·7	138	137·9	4·8	198	197·9	6·9	258	257·8	9·0
19	19·0	0·7	79	79·0	2·8	139	138·9	4·9	199	198·5	6·9	259	258·8	9·0
20	20·0	0·7	80	80·0	2·8	140	139·9	4·9	200	199·9	7·0	260	259·8	9·1
21	21·0	0·7	81	81·0	2·8	141	140·9	4·9	201	200·9	7·0	261	260·8	9·1
22	22·0	0·8	82	81·9	2·9	142	141·9	5·0	202	201·9	7·0	262	261·8	9·1
23	23·0	0·8	83	82·9	2·9	143	142·9	5·0	203	202·9	7·1	263	262·8	9·2
24	24·0	0·8	84	83·9	2·9	144	143·9	5·0	204	203·9	7·1	264	263·8	9·2
25	25·0	0·9	85	84·9	3·0	145	144·9	5·1	205	204·9	7·2	265	264·8	9·2
26	26·0	0·9	86	85·9	3·0	146	145·9	5·1	206	205·9	7·2	266	265·8	9·3
27	27·0	0·9	87	86·9	3·0	147	146·9	5·1	207	206·9	7·2	267	266·8	9·3
28	28·0	1·0	88	87·9	3·1	148	147·9	5·2	208	207·9	7·3	268	267·8	9·4
29	29·0	1·0	89	88·9	3·1	149	148·9	5·2	209	208·9	7·3	269	268·8	9·4
30	30·0	1·0	90	89·9	3·1	150	149·9	5·2	210	209·9	7·3	270	269·8	9·4
31	31·0	1·1	91	90·9	3·2	151	150·9	5·3	211	210·9	7·4	271	270·8	9·5
32	32·0	1·1	92	91·9	3·2	152	151·9	5·3	212	211·9	7·4	272	271·8	9·5
33	33·0	1·2	93	92·9	3·2	153	152·9	5·3	213	212·9	7·4	273	272·8	9·5
34	34·0	1·2	94	93·9	3·3	154	153·9	5·4	214	213·9	7·5	274	273·8	9·6
35	35·0	1·2	95	94·9	3·3	155	154·9	5·4	215	214·9	7·5	275	274·8	9·6
36	36·0	1·3	96	95·9	3·4	156	155·9	5·4	216	215·9	7·5	276	275·8	9·6
37	37·0	1·3	97	96·9	3·4	157	156·9	5·5	217	216·9	7·6	277	276·8	9·7
38	38·0	1·3	98	97·9	3·4	158	157·9	5·5	218	217·9	7·6	278	277·8	9·7
39	39·0	1·4	99	98·9	3·5	159	158·9	5·5	219	218·9	7·6	279	278·8	9·7
40	40·0	1·4	100	99·9	3·5	160	159·9	5·6	220	219·9	7·7	280	279·8	9·8
41	41·0	1·4	101	100·9	3·5	161	160·9	5·6	221	220·9	7·7	281	280·8	9·8
42	42·0	1·5	102	101·9	3·6	162	161·9	5·7	222	221·9	7·7	282	281·8	9·8
43	43·0	1·5	103	102·9	3·6	163	162·9	5·7	223	222·9	7·8	283	282·8	9·9
44	44·0	1·5	104	103·9	3·6	164	163·9	5·7	224	223·9	7·8	284	283·8	9·9
45	45·0	1·6	105	104·9	3·7	165	164·9	5·8	225	224·9	7·9	285	284·8	9·9
46	46·0	1·6	106	105·9	3·7	166	165·9	5·8	226	225·9	7·9	286	285·8	10·0
47	47·0	1·6	107	106·9	3·7	167	166·9	5·8	227	226·9	7·9	287	286·8	10·0
48	48·0	1·7	108	107·9	3·8	168	167·9	5·9	228	227·9	8·0	288	287·8	10·1
49	49·0	1·7	109	108·9	3·8	169	168·9	5·9	229	228·9	8·0	289	288·8	10·1
50	50·0	1·7	110	109·9	3·8	170	169·9	5·9	230	229·9	8·0	290	289·8	10·1
51	51·0	1·8	111	110·9	3·9	171	170·9	6·0	231	230·9	8·1	291	290·8	10·2
52	52·0	1·8	112	111·9	3·9	172	171·9	6·0	232	231·9	8·1	292	291·8	10·2
53	53·0	1·8	113	112·9	3·9	173	172·9	6·0	233	232·9	8·1	293	292·8	10·2
54	54·0	1·9	114	113·9	4·0	174	173·9	6·1	234	233·9	8·2	294	293·8	10·3
55	55·0	1·9	115	114·9	4·0	175	174·9	6·1	235	234·9	8·2	295	294·8	10·3
56	56·0	2·0	116	115·9	4·0	176	175·9	6·1	236	235·9	8·2	296	295·8	10·3
57	57·0	2·0	117	116·9	4·1	177	176·9	6·2	237	236·9	8·3	297	296·8	10·4
58	58·0	2·0	118	117·9	4·1	178	177·9	6·2	238	237·9	8·3	298	297·8	10·4
59	59·0	2·1	119	118·9	4·2	179	178·9	6·2	239	238·9	8·3	299	298·8	10·4
60	60·0	2·1	120	119·9	4·2	180	179·9	6·3	240	239·9	8·4	300	299·8	10·5
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

TABLE 2.

Traverse Table to 3 Degrees=0h. 12m.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	1·0	0·1	61	60·9	3·2	121	120·8	6·3	181	180·8	9·5	241	240·7	12·6
2	2·0	0·1	62	61·9	3·2	122	121·8	6·4	182	181·8	9·5	242	241·7	12·7
3	3·0	0·2	63	62·9	3·3	123	122·8	6·4	183	182·7	9·6	243	242·7	12·7
4	4·0	0·2	64	63·9	3·3	124	123·8	6·5	184	183·7	9·6	244	243·7	12·8
5	5·0	0·3	65	64·9	3·4	125	124·8	6·5	185	184·7	9·7	245	244·7	12·8
6	6·0	0·3	66	65·9	3·5	126	125·8	6·6	186	185·7	9·7	246	245·7	12·9
7	7·0	0·4	67	66·9	3·5	127	126·8	6·6	187	186·7	9·8	247	246·7	12·9
8	8·0	0·4	68	67·9	3·6	128	127·8	6·7	188	187·7	9·8	248	247·7	13·0
9	9·0	0·5	69	68·9	3·6	129	128·8	6·8	189	188·7	9·9	249	248·7	13·0
10	10·0	0·5	70	69·9	3·7	130	129·8	6·8	190	189·7	9·9	250	249·7	13·1
11	11·0	0·6	71	70·9	3·7	131	130·8	6·9	191	190·7	10·0	251	250·7	13·1
12	12·0	0·6	72	71·9	3·8	132	131·8	6·9	192	191·7	10·0	252	251·7	13·2
13	13·0	0·7	73	72·9	3·8	133	132·8	7·0	193	192·7	10·1	253	252·7	13·2
14	14·0	0·7	74	73·9	3·9	134	133·8	7·0	194	193·7	10·2	254	253·7	13·3
15	15·0	0·8	75	74·9	3·9	135	134·8	7·1	195	194·7	10·2	255	254·7	13·3
16	16·0	0·8	76	75·9	4·0	136	135·8	7·1	196	195·7	10·3	256	255·6	13·4
17	17·0	0·9	77	76·9	4·0	137	136·8	7·2	197	196·7	10·3	257	256·6	13·5
18	18·0	0·9	78	77·9	4·1	138	137·8	7·2	198	197·7	10·4	258	257·6	13·5
19	19·0	1·0	79	78·9	4·1	139	138·8	7·3	199	198·7	10·4	259	258·6	13·6
20	20·0	1·0	80	79·9	4·2	140	139·8	7·3	200	199·7	10·5	260	259·6	13·6
21	21.0	1·1	81	80·9	4·2	141	140·8	7·4	201	200·7	10·5	261	260·6	13·7
22	22·0	1·2	82	81·9	4·3	142	141·8	7·4	202	201·7	10·6	262	261·6	13·7
23	23·0	1·2	83	82·9	4·3	143	142·8	7·5	203	202·7	10·6	263	262·6	13·8
24	24·0	1·3	84	83·9	4·4	144	143·8	7·5	204	203·7	10·7	264	263·6	13·8
25	25·0	1·3	85	84·9	4·4	145	144·8	7·6	205	204·7	10·7	265	264·6	13·9
26	26·0	1·4	86	85·9	4·5	146	145·8	7·6	206	205·7	10·8	266	265·6	13·9
27	27·0	1·4	87	86·9	4·6	147	146·8	7·7	207	206·7	10·8	267	266·6	14·0
28	28·0	1·5	88	87·9	4·6	148	147·8	7·7	208	207·7	10·9	268	267·6	14·0
29	29·0	1·5	89	88·9	4·7	149	148·8	7·8	209	208·7	10·9	269	268·6	14·1
30	30·0	1·6	90	89·9	4·7	150	149·8	7·9	210	209·7	11·0	270	269·6	14·1
31	31·0	1·6	91	90·9	4·8	151	150·8	7·9	211	210·7	11·0	271	270·6	14·2
32	32·0	1·7	92	91·9	4·8	152	151·8	8·0	212	211·7	11·1	272	271·6	14·2
33	33·0	1·7	93	92·9	4·9	153	152·8	8·0	213	212·7	11·1	273	272·6	14·3
34	34·0	1·8	94	93·9	4·9	154	153·8	8·1	214	213·7	11·2	274	273·6	14·3
35	35·0	1·8	95	94·9	5·0	155	154·8	8·1	215	214·7	11·3	275	274·6	14·4
36	36.0	1·9	96	95·9	5·0	156	155·8	8·2	216	215·7	11·3	276	275·6	14·4
37	36·9	1·9	97	96·9	5·1	157	156·8	8·2	217	216·7	11·4	277	276·6	14·5
38	37·9	2·0	98	97·9	5·1	158	157·8	8·3	218	217·7	11·4	278	277·6	14·5
39	38·9	2·0	99	98·9	5·2	159	158·8	8·3	219	218·7	11·5	279	278·6	14·6
40	39·9	2·1	100	99·9	5·2	160	159·8	8·4	220	219·7	11·5	280	279·6	14·7
41	40·9	2·1	101	100·9	5·3	161	160·8	8·4	221	220·7	11·6	281	280·6	14·7
42	41·9	2·2	102	101·9	5·3	162	161·8	8·5	222	221·7	11·6	282	281·6	14·8
43	42·9	2·3	103	102·9	5·4	163	162·8	8·5	223	222·7	11·7	283	282·6	14·8
44	43·9	2·3	104	103·9	5.4	164	163·8	8·6	224	223·7	11·7	284	283·6	14·9
45	44·9	2·4	105	104·9	5·5	165	164·8	8·6	225	224·7	11·8	285	284·6	14·9
46	45·9	2·4	106	105·9	5·5	166	165·8	8·7	226	225·7	11·8	286	285·6	15·0
47	46·9	2·5	107	106·9	5·6	167	166·8	8·7	227	226·7	11·9	287	286·6	15·0
48	47·9	2·5	108	107·9	5·7	168	167·8	8·8	228	227·7	11·9	288	287·6	15·1
49	48·9	2·6	109	108·9	5·7	169	168·8	8·8	229	228·7	12·0	289	288·6	15·1
50	49·9	2·6	110	109·8	5·8	170	169·8	8·9	230	229·7	12·0	290	289·6	15·2
51	50·9	2·7	111	110·8	5·8	171	170·8	8·9	231	230·7	12·1	291	290·6	15·2
52	51·9	2·7	112	111·8	5·9	172	171·8	9·0	232	231·7	12·1	292	291·6	15·3
53	52·9	2·8	113	112·8	5·9	173	172·8	9.1	233	232·7	12·2	293	292·6	15·3
54	53·9	2·8	114	113·8	6·0	174	173·8	9·1	234	233·7	12·2	294	293·6	15·4
55	54·9	2·9	115	114·8	6·0	175	174·8	9·2	235	234·7	12.3	295	294·6	15·4
56	55·9	2·9	116	115·8	6·1	176	175·8	9·2	236	235·7	12·4	296	295·6	15·5
57	56·9	3·0	117	116·8	6·1	177	176·8	9·3	237	236·7	12·4	297	296·6	15·5
58	57·9	3·0	118	117·8	6·2	178	177·8	9·3	238	237·7	12·5	298	297·6	15·6
59	58·9	3·1	119	118·8	6·2	179	178·8	9·4	239	238.7	12·5	299	298·6	15·6
60	59·9	3·1	120	119·8	6·3	180	179·8	9·4	240	239.7	12·6	300	299·6	15·7
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

87°=5h. 48m.

TABLE 2.

Traverse Table to 4 Degrees=0h 16m.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	1·0	0·1	61	60·9	4·3	121	120·7	8·4	181	180·6	12·6	241	240·4	16·8
2	2·0	0·1	62	61·8	4·3	122	121·7	8·5	182	181·6	12·7	242	241·4	16·9
3	3·0	0·2	63	62·8	4·4	123	122·7	8·6	183	182·6	12·8	243	242·4	17·0
4	4·0	0·3	64	63·8	4·5	124	123·7	8·6	184	183·6	12·8	244	243·4	17·0
5	5·0	0·3	65	64·8	4·5	125	124·7	8·7	185	184·5	12·9	245	244·4	17·1
6	6·0	0·4	66	65·8	4·6	126	125·7	8·8	186	185·5	13·0	246	245·4	17·2
7	7·0	0·5	67	66·8	4·7	127	126·7	8·9	187	186·5	13·0	247	246·4	17·2
8	8·0	0·6	68	67·8	4·7	128	127·7	8·9	188	187·5	13·1	248	247·4	17·3
9	9·0	0·6	69	68·8	4·8	129	128·7	9·0	189	188·5	13·2	249	248·4	17·4
10	10·0	0·7	70	69·8	4·9	130	129·7	9·1	190	189·5	13·3	250	249·4	17·4
11	11·0	0·8	71	70·8	5·0	131	130·7	9·1	191	190·5	13·3	251	250·4	17·5
12	12·0	0·8	72	71·8	5·0	132	131·7	9·2	192	191·5	13·4	252	251·4	17·6
13	13·0	0·9	73	72·8	5·1	133	132·7	9·3	193	192·5	13·5	253	252·4	17·6
14	14·0	1·0	74	73·8	5·2	134	133·7	9·3	194	193·5	13·5	254	253·4	17·7
15	15·0	1·0	75	74·8	5·2	135	134·7	9·4	195	194·5	13·6	255	254·4	17·8
16	16·0	1·1	76	75·8	5·3	136	135·7	9·5	196	195·5	13·7	256	255·4	17·9
17	17·0	1·2	77	76·8	5·4	137	136·7	9·6	197	196·5	13·7	257	256·4	17·9
18	18·0	1·3	78	77·8	5·5	138	137·7	9·6	198	197·5	13·8	258	257·4	18·0
19	19·0	1·3	79	78·8	5·5	139	138·7	9·7	199	198·5	13·9	259	258·4	18·1
20	20·0	1·4	80	79·8	5·6	140	139·7	9·8	200	199·5	14·0	260	259·4	18·1
21	20·9	1·5	81	80·8	5·7	141	140·7	9·8	201	200·5	14·0	261	260·4	18·2
22	21·9	1·5	82	81·8	5·7	142	141·7	9·9	202	201·5	14·1	262	261·4	18·3
23	22·9	1·6	83	82·8	5·8	143	142·7	10·0	203	202·5	14·2	263	262·4	18·3
24	23·9	1·7	84	83·8	5·9	144	143·6	10·0	204	203·5	14·2	264	263·4	18·4
25	24·9	1·7	85	84·8	5·9	145	144·6	10·1	205	204·5	14·3	265	264·4	18·5
26	25·9	1·8	86	85·8	6·0	146	145·6	10·2	206	205·5	14·4	266	265·4	18·6
27	26·9	1·9	87	86·8	6·1	147	146·6	10·3	207	206·5	14·4	267	266·3	18·6
28	27·9	2·0	88	87·8	6·1	148	147·6	10·3	208	207·5	14·5	268	267·3	18·7
29	28·9	2·0	89	88·8	6·2	149	148·6	10·4	209	208·5	14·6	269	268·3	18·8
30	29·9	2·1	90	89·8	6·3	150	149·6	10·5	210	209·5	14·6	270	269·3	18·8
31	30·9	2·2	91	90·8	6·3	151	150·6	10·5	211	210·5	14·7	271	270·3	18·9
32	31·9	2·2	92	91·8	6·4	152	151·6	10·6	212	211·5	14·8	272	271·3	19·0
33	32·9	2·3	93	92·8	6·5	153	152·6	10·7	213	212·5	14·9	273	272·3	19·0
34	33·9	2·4	94	93·8	6·6	154	153·6	10·7	214	213·5	14·9	274	273·3	19·1
35	34·9	2·4	95	94·8	6·6	155	154·6	10·8	215	214·5	15·0	275	274·3	19·2
36	35·9	2·5	96	95·8	6·7	156	155·6	10·9	216	215·5	15·1	276	275·3	19·3
37	36·9	2·6	97	96·8	6·8	157	156·6	11·0	217	216·5	15·1	277	276·3	19·3
38	37·9	2·7	98	97·8	6·8	158	157·6	11·0	218	217·5	15·2	278	277·3	19·4
39	38·9	2·7	99	98·8	6·9	159	158·6	11·1	219	218·5	15·3	279	278·3	19·5
40	39·9	2·8	100	99·8	7·0	160	159·6	11·2	220	219·5	15·3	280	279·3	19·5
41	40·9	2·9	101	100·8	7·0	161	160·6	11·2	221	220·5	15·4	281	280·3	19·6
42	41·9	2·9	102	101·8	7·1	162	161·6	11·3	222	221·5	15·5	282	281·3	19·7
43	42·9	3·0	103	102·7	7·2	163	162·6	11·4	223	222·5	15·6	283	282·3	19·7
44	43·9	3·1	104	103·7	7·3	164	163·6	11·4	224	223·5	15·6	284	283·3	19·8
45	44·9	3·1	105	104·7	7·3	165	164·6	11·5	225	224·5	15·7	285	284·3	19·9
46	45·9	3·2	106	105·7	7·4	166	165·6	11·6	226	225·4	15·8	286	285·3	20·0
47	46·9	3·3	107	106·7	7·5	167	166·6	11·6	227	226·4	15·8	287	286·3	20·0
48	47·9	3·3	108	107·7	7·5	168	167·6	11·7	228	227·4	15·9	288	287·3	20·1
49	48·9	3·4	109	108·7	7·6	169	168·6	11·8	229	228·4	16·0	289	288·3	20·2
50	49·9	3·5	110	109·7	7·7	170	169·6	11·9	230	229·4	16·0	290	289·3	20·2
51	50·9	3·6	111	110·7	7·7	171	170·6	11·9	231	230·4	16·1	291	290·3	20·3
52	51·9	3·6	112	111·7	7·8	172	171·6	12·0	232	231·4	16·2	292	291·3	20·4
53	52·9	3·7	113	112·7	7·9	173	172·6	12·1	233	232·4	16·3	293	292·3	20·4
54	53·9	3·8	114	113·7	8·0	174	173·6	12·1	234	233·4	16·3	294	293·3	20·5
55	54·9	3·8	115	114·7	8·0	175	174·6	12·2	235	234·4	16·4	295	294·3	20·6
56	55·9	3·9	116	115·7	8·1	176	175·6	12·3	236	235·4	16·5	296	295·3	20·6
57	56·9	4·0	117	116·7	8·2	177	176·6	12·3	237	236·4	16·5	297	296·3	20·7
58	57·9	4·0	118	117·7	8·2	178	177·6	12·4	238	237·4	16·6	298	297·3	20·8
59	58·9	4·1	119	118·7	8·3	179	178·6	12·5	239	238·4	16·7	299	298·3	20·9
60	59·9	4·2	120	119·7	8·4	180	179·6	12·6	240	239·4	16·7	300	299·3	20·9
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

86° = 5h. 44m.

TABLE 2.

Traverse Table to 5 Degrees = 0h. 20m.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	1·0	0·1	61	60·8	5·3	121	120·5	10·5	181	180·3	15·8	241	240·1	21·0
2	2·0	0·2	62	61·8	5·4	122	121·5	10·6	182	181·3	15·9	242	241·1	21·1
3	3·0	0·3	63	62·8	5·5	123	122·5	10·7	183	182·3	15·9	243	242·1	21·2
4	4·0	0·3	64	63·8	5·6	124	123·5	10·8	184	183·3	16·0	244	243·1	21·3
5	5·0	0·4	65	64·8	5·7	125	124·5	10·9	185	184·3	16·1	245	244·1	21·4
6	6·0	0·5	66	65·7	5·8	126	125·5	11·0	186	185·3	16·2	246	245·1	21·4
7	7·0	0·6	67	66·7	5·8	127	126·5	11·1	187	186·3	16·3	247	246·1	21·5
8	8·0	0·7	68	67·7	5·9	128	127·5	11·2	188	187·3	16·4	248	247·1	21·6
9	9·0	0·8	69	68·7	6·0	129	128·5	11·2	189	188·3	16·5	249	248·1	21·7
10	10·0	0·9	70	69·7	6·1	130	129·5	11·3	190	189·3	16·6	250	249·0	21·8
11	11·0	1·0	71	70·7	6·2	131	130·5	11·4	191	190·3	16·6	251	250·0	21·9
12	12·0	1·0	72	71·7	6·3	132	131·5	11·5	192	191·3	16·7	252	251·0	22·0
13	13·0	1·1	73	72·7	6·4	133	132·5	11·6	193	192·3	16·8	253	252·0	22·1
14	13·9	1·2	74	73·7	6·4	134	133·5	11·7	194	193·3	16·9	254	253·0	22·1
15	14·9	1·3	75	74·7	6·5	135	134·5	11·8	195	194·3	17·0	255	254·0	22·2
16	15·9	1·4	76	75·7	6·6	136	135·5	11·9	196	195·3	17·1	256	255·0	22·3
17	16·9	1·5	77	76·7	6·7	137	136·5	11·9	197	196·3	17·2	257	256·0	22·4
18	17·9	1·6	78	77·7	6·8	138	137·5	12·0	198	197·2	17·3	258	257·0	22·5
19	18·9	1·7	79	78·7	6·9	139	138·5	12·1	199	198·2	17·3	259	258·0	22·6
20	19·9	1·7	80	79·7	7·0	140	139·5	12·2	200	199·2	17·4	260	259·0	22·7
21	20·9	1.8	81	80·7	7·1	141	140·5	12·3	201	200·2	17·5	261	260·0	22·7
22	21·9	1·9	82	81·7	7·1	142	141·5	12·4	202	201·2	17·6	262	261·0	22·8
23	22·9	2·0	83	82·7	7·2	143	142·5	12·5	203	202·2	17·7	263	262·0	22·9
24	23·9	2·1	84	83·7	7·3	144	143·5	12·6	204	203·2	17·8	264	263·0	23·0
25	24·9	2·2	85	84·7	7·4	145	144·4	12·6	205	204·2	17·9	265	264·0	23·1
26	25·9	2·3	86	85·7	7·5	146	145·4	12·7	206	205·2	18·0	266	265·0	23·2
27	26·9	2·4	87	86·7	7·6	147	146·4	12·8	207	206·2	18·0	267	266·0	23·3
28	27·9	2·4	88	87·7	7·7	148	147·4	12·9	208	207·2	18·1	268	267·0	23·4
29	28·9	2·5	89	88·7	7·8	149	148·4	13·0	209	208·2	18·2	269	268·0	23·4
30	29·9	2·6	90	89·7	7·8	150	149·4	13·1	210	209·2	18·3	270	269·0	23·5
31	30·9	2·7	91	90·7	7·9	151	150·4	13·2	211	210·2	18·4	271	270·0	23·6
32	31·9	2·8	92	91·6	8·0	152	151·4	13·2	212	211·2	18·5	272	271·0	23·7
33	32·9	2·9	93	92·6	8·1	153	152·4	13·3	213	212·2	18·6	273	272·0	23·8
34	33·9	3·0	94	93·6	8·2	154	153·4	13·4	214	213·2	18·7	274	273·0	23·9
35	34·9	3·1	95	94·6	8·3	155	154·4	13·5	215	214·2	18·7	275	274·0	24·0
36	35·9	3·1	96	95·6	8·4	156	155·4	13·6	216	215·2	18·8	276	274·9	24·1
37	36·9	3·2	97	96·6	8·5	157	156·4	13·7	217	216·2	18·9	277	275·9	24·1
38	37·9	3·3	98	97·6	8·5	158	157·4	13·8	218	217·2	19·0	278	276·9	24·2
39	38·9	3·4	99	98·6	8·6	159	158·4	13·9	219	218·2	19·1	279	277·9	24·3
40	39·8	3·5	100	99·6	8·7	160	159·4	13·9	220	219·2	19·2	280	278·9	24·4
41	40·8	3·6	101	100·6	8·8	161	160·4	14·0	221	220·2	19·3	281	279·9	24·5
42	41·8	3·7	102	101·6	8·9	162	161·4	14·1	222	221·2	19·3	282	280·9	24·6
43	42·8	3·7	103	102·6	9·0	163	162·4	14·2	223	222·2	19·4	283	281·9	24·7
44	43·8	3·8	104	103·6	9·1	164	163·4	14·3	224	223·1	19·5	284	282·9	24·8
45	44·8	3·9	105	104·6	9·2	165	164·4	14·4	225	224·1	19·6	285	283·9	24·8
46	45·8	4·0	106	105·6	9·2	166	165·4	14·5	226	225·1	19·7	286	284·9	24·9
47	46·8	4·1	107	106·6	9·3	167	166·4	14·6	227	226·1	19·8	287	285·9	25·0
48	47·8	4·2	108	107·6	9·4	168	167·4	14·6	228	227·1	19·9	288	286·9	25·1
49	48·8	4·3	109	108·6	9·5	169	168·4	14·7	229	228·1	20·0	289	287·9	25·2
50	49·8	4·4	110	109·6	9·6	170	169·4	14·8	230	229·1	20·0	290	288·9	25·3
51	50·8	4 4	111	110·6	9·7	171	170·3	14·9	231	230·1	20·1	291	289·9	25·4
52	51·8	4·5	112	111·6	9·8	172	171·3	15·0	232	231·1	20·2	292	290·9	25·4
53	52·8	4·6	113	112·6	9·8	173	172·3	15·1	233	232·1	20·3	293	291·9	25·5
54	53·8	4·7	114	113·6	9·9	174	173·3	15·2	234	233·1	20·4	294	292·9	25·6
55	54·8	4·8	115	114·6	10·0	175	174·3	15·3	235	234·1	20·5	295	293·9	25·7
56	55·8	4·9	116	115·6	10·1	176	175·3	15·3	236	235·1	20·6	296	294·9	25·8
57	56·8	5·0	117	116·6	10·2	177	176·3	15·4	237	236·1	20·7	297	295·9	25·9
58	57·8	5·1	118	117·6	10·3	178	177·3	15·5	238	237·1	20·7	298	296·9	26·0
59	58·8	5·1	119	118·6	10·4	179	178·3	15·6	239	238·1	20·8	299	297·9	26·0
60	59·8	5·2	120	119·6	10·5	180	179·3	15·7	240	239·1	20·9	300	298·9	26·1
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

85° = 5h. 40m.

TABLE 2.

Traverse Table to 6 Degrees=0h. 24m.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	1·0	0·1	61	60·7	6·4	121	120·3	12·6	181	180·0	18·9	241	239·7	25·2
2	2·0	0·2	62	61·7	6·5	122	121·3	12·8	182	181·0	19·0	242	240·7	25·3
3	3·0	0·3	63	62·7	6·6	123	122·3	12·9	183	182·0	19·1	243	241·7	25·4
4	4·0	0·4	64	63·6	6·7	124	123·3	13·0	184	183·0	19·2	244	242·7	25·5
5	5·0	0·5	65	64·6	6 8	125	124·3	13·1	185	184·0	19·3	245	243·7	25·6
6	6·0	0·6	66	65·6	6·9	126	125·3	13·2	186	185·0	19·4	246	244·7	25·7
7	7·0	0·7	67	66·6	6·0	127	126·3	13·3	187	186·0	19·5	247	245·6	25·8
8	8·0	0·8	68	67·6	7·1	128	127·3	13·4	188	187·0	19·7	248	246·6	25·9
9	9·0	0·9	69	68·6	7·2	129	128·3	13·5	189	188·0	19·8	249	247·6	26·0
10	9·9	1·0	70	69·6	7·3	130	129·3	13·6	190	189·0	19·9	250	248·6	26·1
11	10·9	1·1	71	70·6	7·4	131	130·3	13·7	191	190·0	20·0	251	249·6	26·2
12	11·9	1·3	72	71·6	7·5	132	131·3	13·8	192	190·9	20·1	252	250·6	26·3
13	12·9	1·4	73	72·6	7·6	133	132·3	13·9	193	191·9	20·2	253	251·6	26·4
14	13·9	1·5	74	73·6	7·7	134	133·3	14·0	194	192·9	20·3	254	252·6	26·6
15	14·9	1·6	75	74·6	7·8	135	134·3	14·1	195	193·9	20·4	255	253·6	26·7
16	15·9	1·7	76	75·6	7·9	136	135·3	14·2	196	194·9	20·5	256	254·6	26·8
17	16·9	1·8	77	76·6	8·0	137	136·2	14·3	197	195·9	20·6	257	255·6	26·9
18	17·9	1·9	78	77·6	8·2	138	137·2	14·4	198	196·9	20·7	258	256·6	27·0
19	18·9	2·0	79	78·6	8·3	139	138·2	14·5	199	197·9	20·8	259	257·6	27·1
20	19·9	2·1	80	79·6	8·4	140	139·2	14·6	200	198·9	20·9	260	258·6	27·2
21	20·9	2·2	81	80·6	8·5	141	140·2	14·7	201	199·9	21·1	261	259·6	27·3
22	21·9	2·3	82	81·6	8·6	142	141·2	14·8	202	200·9	21·2	262	260·6	27·4
23	22·9	2·4	83	82·5	8·7	143	142·2	14·9	203	201·9	21·3	263	261·6	27·5
24	23·9	2·5	84	83·5	8·8	144	143·2	15·1	204	202·9	21·4	264	262·6	27·6
25	24·9	2·6	85	84·5	8·9	145	144·2	15·2	205	203·9	21·5	265	263·5	27·7
26	25·9	2·7	86	85·5	9·0	146	145·2	15·3	206	204·9	21·6	266	264·5	27·8
27	26·9	2·8	87	86·5	9·1	147	146·2	15·4	207	205·9	21·7	267	265·5	27·9
28	27·8	2·9	88	87·5	9·2	148	147·2	15·5	208	206·9	21 8	268	266·5	28·1
29	28·8	3·0	89	88·5	9·3	149	148·2	15·6	209	207·9	21·9	269	267·5	28·2
30	29·8	3·1	90	89·5	9.4	150	149·2	15·7	210	208·8	22·0	270	268·5	28·3
31	30·8	3·2	91	90·5	9·5	151	150·2	15·8	211	209·8	22·1	271	269·5	28·4
32	31·8	3·3	92	91·5	9·6	152	151·2	15·9	212	210·8	22·2	272	270·5	28·5
33	32·8	3·4	93	92·5	9·7	153	152·2	16·0	213	211·8	22·3	273	271·5	28·6
34	33·8	3·6	94	93·5	9·8	154	153·2	16·1	214	212·8	22·4	274	272·5	28·7
35	34·8	3·7	95	94·5	9·9	155	154·2	16·2	215	213·8	22·5	275	273·5	28·8
36	35·8	3·8	96	95·5	10·0	156	155·1	16·3	216	214·8	22·6	276	274·5	28·9
37	36·8	3·9	97	96·5	10·1	157	156·1	16·4	217	215·8	22·7	277	275·5	29·0
38	37·8	4·0	98	97·5	10·2	158	157·1	16·5	218	216·8	22·8	278	276·5	29·1
39	38·8	4·1	99	98·5	10·3	159	158·1	16·6	219	217·8	22·9	279	277·5	29·2
40	39·8	4·2	100	99·5	10·5	160	159·1	16·7	220	218·8	23·0	280	278·5	29·3
41	40·8	4·3	101	100·4	10·6	161	160·1	16·8	221	219·8	23·1	281	279·5	29·4
42	41·8	4·4	102	101·4	10·7	162	161·1	16·9	222	220·8	23·2	282	280·5	29·5
43	42·8	4·5	103	102·4	10·8	163	162·1	17·0	223	221·8	23·3	283	281·4	29·6
44	43·8	4·6	104	103·4	10·9	164	163·1	17·1	224	222·8	23·4	284	282·4	29·7
45	44·8	4·7	105	104·4	11·0	165	164·1	17·2	225	223·8	23·5	285	283·4	29·8
46	45·7	4·8	106	105·4	11·1	166	165·1	17·4	226	224·8	23·6	286	284·4	29·9
47	46·7	4·9	107	106·4	11·2	167	166·1	17·5	227	225·8	23·7	287	285·4	30·0
48	47·7	5·0	108	107·4	11·3	168	167·1	17·6	228	226·8	23·8	288	286·4	30·1
49	48·7	5·1	109	108·4	11·4	169	168·1	17·7	229	227·7	23·9	289	287·4	30·2
50	49·7	5·2	110	109·4	11·5	170	169·1	17·8	230	228·7	24·0	290	288·4	30·3
51	50·7	5·3	111	110·4	11·6	171	170·1	17·9	231	229·7	24·1	291	289·4	30·4
52	51·7	5·4	112	111·4	11·7	172	171·1	18·0	232	230·7	24·3	292	290·4	30·5
53	52·7	5·5	113	112·4	11·8	173	172·1	18·1	233	231·7	24·4	293	291·4	30·6
54	53·7	5·6	114	113·4	11·9	174	173·0	18·2	234	232·7	24·5	294	292·4	30·7
55	54·7	5·7	115	114·4	12·0	175	174·0	18·3	235	233·7	24·6	295	293·4	30·8
56	55·7	5·9	116	115·4	12·1	176	175·0	18·4	236	234·7	24·7	296	294·4	30·9
57	56·7	6·0	117	116·4	12·2	177	176·0	18·5	237	235·7	24·8	297	295·4	31·0
58	57·7	6·1	118	117·4	12·3	178	177·0	18·6	238	236·7	24·9	298	296·4	31·1
59	58·7	6·2	119	118·4	12·4	179	178·0	18·7	239	237·7	25·0	299	297·4	31·3
60	59·7	6·3	120	119·4	12·5	180	179·0	18·8	240	238·7	25·1	300	298·4	31·4
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

84°=5h. 36m.

TABLE 2.

Traverse Table to 7 Degrees = 0h. 28m.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	1·0	0·1	61	60·5	7·4	121	120·1	14·7	181	179·7	22·1	241	239·2	29·4
2	2·0	0·2	62	61·5	7·6	122	121·1	14·9	182	180·6	22·2	242	240·2	29·5
3	3·0	0·4	63	62·5	7·7	123	122·1	15·0	183	181·6	22·3	243	241·2	29·6
4	4·0	0·5	64	63·5	7·8	124	123·1	15·1	184	182·6	22·4	244	242·2	29·7
5	5·0	0·6	65	64·5	7·9	125	124·1	15·2	185	183·6	22·5	245	243·2	29·9
6	6·0	0·7	66	65·5	8·0	126	125·1	15·4	186	184·6	22·7	246	244·2	30·0
7	6·9	0·9	67	66·5	8·2	127	126·1	15·5	187	185·6	22·8	247	245·2	30·1
8	7·9	1·0	68	67·5	8·3	128	127·0	15·6	188	186·6	22·9	248	246·2	30·2
9	8·9	1·1	69	68·5	8·4	129	128·0	15·7	189	187·6	23·0	249	247·1	30·3
10	9·9	1·2	70	69·5	8·5	130	129·0	15·8	190	188·6	23·2	250	248·1	30·5
11	10·9	1·3	71	70·5	8·7	131	130·0	16·0	191	189·6	23·3	251	249·1	30·6
12	11·9	1·5	72	71·5	8·8	132	131·0	16·1	192	190·6	23·4	252	250·1	30·7
13	12·9	1·6	73	72·5	8.9	133	132·0	16·2	193	191·6	23·5	253	251·1	30·8
14	13·9	1·7	74	73·4	9·0	134	133·0	16·3	194	192·6	23·6	254	252·1	31·0
15	14·9	1·8	75	74·4	9·1	135	134·0	16·5	195	193·5	23·8	255	253·1	31·1
16	15·9	1·9	76	75·4	9·3	136	135·0	16·6	196	194·5	23·9	256	254·1	31·2
17	16·9	2·1	77	76·4	9·4	137	136·0	16·7	197	195·5	24·0	257	255·1	31·3
18	17·9	2·2	78	77·4	9·5	138	137·0	16·8	198	196·5	24·1	258	256·1	31·5
19	18·9	2·3	79	78·4	9·6	139	138·0	16·9	199	197·5	24·3	259	257·1	31·6
20	19·9	2·4	80	79·4	9·7	140	139·0	17·1	200	198·5	24·4	260	258·1	31·7
21	20·8	2·6	81	80·4	9·9	141	139·9	17·2	201	199·5	24·5	261	259·1	31·8
22	21·8	2·7	82	81·4	10·0	142	140·9	17·3	202	200·5	24·6	262	260·0	31·9
23	22·8	2·8	83	82·4	10·1	143	141·9	17·4	203	201·5	24·7	263	261·0	32·1
24	23·8	2·9	84	83·4	10·2	144	142·9	17·5	204	202·5	24·9	264	262·0	32·2
25	24·8	3·0	85	84·4	10·4	145	143·9	17·7	205	203·5	25·0	265	263·0	32·3
26	25·8	3·2	86	85·4	10·5	146	144·9	17·8	206	204·5	25·1	266	264·0	32·4
27	26·8	3·3	87	86·4	10·6	147	145·9	17·9	207	205·5	25·2	267	265·0	32·5
28	27·8	3·4	88	87·3	10·7	148	146·9	18·0	208	206·5	25·3	268	266·0	32·7
29	28·8	3·5	89	88·3	10·8	149	147·9	18·2	209	207·5	25·5	269	267·0	32·8
30	29·8	3·7	90	89·3	11·0	150	148·9	18·3	210	208·5	25·6	270	268·0	32·9
31	30·8	3·8	91	90·3	11·1	151	149·9	18·4	211	209·4	25·7	271	269·0	33·0
32	31·8	3·9	92	91·3	11·2	152	150·9	18·5	212	210·4	25·8	272	270·0	33·1
33	32·8	4·0	93	92·3	11·3	153	151·9	18·6	213	211·4	26·0	273	271·0	33·3
34	33·7	4·1	94	93·3	11·5	154	152·9	18·8	214	212·4	26·1	274	272·0	33·4
35	34·7	4·3	95	94·3	11·6	155	153·8	18·9	215	213·4	26·2	275	273·0	33·5
36	35·7	4·4	96	95·3	11·7	156	154·8	19·0	216	214·4	26·3	276	273·9	33·6
37	36·7	4·5	97	96·3	11·8	157	155·8	19·1	217	215·4	26·4	277	274·9	33·8
38	37·7	4·6	98	97·3	11·9	158	156·8	19·3	218	216·4	26·6	278	275·9	33·9
39	38·7	4·8	99	98·3	12·1	159	157·8	19·4	219	217·4	26·7	279	276·9	34·0
40	39·7	4·9	100	99·3	12·2	160	158·8	19·5	220	218·4	26·8	280	277·9	34·1
41	40·7	5·0	101	100·2	12·3	161	159·8	19·6	221	219·4	26·9	281	278·9	34·2
42	41·7	5·1	102	101·2	12·4	162	160·8	19·7	222	220·3	27·1	282	279·9	34·4
43	42·7	5·2	103	102·2	12·6	163	161·8	19·9	223	221·3	27·2	283	280·9	34·5
44	43·7	5·4	104	103·2	12·7	164	162·8	20·0	224	222·3	27·3	284	281·9	34·6
45	44·7	5·5	105	104·2	12·8	165	163·8	20·1	225	223·3	27·4	285	282·9	34·7
46	45·7	5·6	106	105·2	12·9	166	164·8	20·2	226	224·3	27·5	286	283·9	34·9
47	46·6	5·7	107	106·2	13·0	167	165·8	20·4	227	225·3	27·7	287	284·9	35·0
48	47·6	5·8	108	107·2	13·2	168	166·7	20·5	228	226·5	27·8	288	285·9	35·1
49	48·6	6·0	109	108·2	13·3	169	167·7	20·6	229	227·3	27·9	289	286·8	35·2
50	49·6	6·1	110	109·2	13·4	170	168·7	20·7	230	228·3	28·0	290	287·8	35·3
51	50·6	6·2	111	110·2	13·5	171	169·7	20·8	231	229·3	28·2	291	288·8	35·5
52	51·6	6·3	112	111·2	13·6	172	170·7	21·0	232	230·3	28·3	292	289·8	35·6
53	52·6	6·5	113	112·2	13·8	173	171·7	21·1	233	231·3	28·4	293	290·8	35·7
54	53·6	6·6	114	113·2	13·9	174	172·7	21·2	234	232·3	28·5	294	291·8	35·8
55	54·6	6·7	115	114·1	14·0	175	173·7	21·3	235	233·2	28·6	295	292·8	36·0
56	55·6	6·8	116	115·1	14·1	176	174·7	21·4	236	234·2	28·8	296	293·8	36·1
57	56·6	6·9	117	116·1	14·3	177	175·7	21·6	237	235·2	28·9	297	294·8	36·2
58	57·6	7·1	118	117·1	14·4	178	176·7	21·7	238	236·2	29·0	298	295·8	36·3
59	58·6	7·2	119	118·1	14·5	179	177·7	21·8	239	237·2	29·1	299	296·8	36·4
60	59·6	7·3	120	119·1	14·6	180	178·7	21·9	240	238·2	29·2	300	297·8	36·6
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

83° = 5h. 32m.

TABLE 2.

Traverse Table to 8 Degrees = 0 h. 32m.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	1·0	0·1	61	60·4	8·5	121	119·8	16·8	181	179·2	25·2	241	238·7	33·5
2	2·0	0·3	62	61·4	8·6	122	120·8	17·0	182	180·2	25·3	242	239·6	33·7
3	3·0	0·4	63	62·4	8·8	123	121·8	17·1	183	181·2	25·5	243	240·6	33·8
4	4·0	0·6	64	63·4	8·9	124	122·8	17·3	184	182·2	25·6	244	241·6	34·0
5	5·0	0·7	65	64·4	9·0	125	123·8	17·4	185	183·2	25·7	245	242·6	34·1
6	5·9	0·8	66	65·4	9·2	126	124·8	17·5	186	184·2	25·9	246	243·6	34·2
7	6·9	1·0	67	66·3	9·3	127	125·8	17·7	187	185·2	26·0	247	244·6	34·4
8	7·9	1·1	68	67·3	9·5	128	126·8	17·8	188	186·2	26·2	248	245. 6	34·5
9	8·9	1·3	69	68·3	9·6	129	127·7	18·0	189	187·2	26·3	249	246·6	34·7
10	9·9	1·4	70	69·3	9·7	130	128·7	18·1	190	188·2	26·4	250	247·6	34·8
11	10·9	1·5	71	70·3	9·9	131	129·7	18·2	191	189·1	26·6	251	248·6	34·9
12	11·9	1·7	72	71·3	10·0	132	130·7	18·4	192	190·1	26·7	252	249·5	35·1
13	12·9	1·8	73	72·3	10·2	133	131·7	18·5	193	191·1	26·9	253	250·5	35·2
14	13·9	1·9	74	73·3	10·3	134	132·7	18·6	194	192·1	27·0	254	251·5	35·3
15	14·8	2·1	75	74·3	10·4	135	133·7	18·8	195	193·1	27·1	255	252·5	35·5
16	15·8	2·2	76	75·3	10·6	136	134·7	18·9	196	194·1	27·3	256	253·5	35·6
17	16·8	2·4	77	76·3	10·7	137	135·7	19·1	197	195·1	27·4	257	254·5	35·8
18	17·8	2·5	78	77·2	10·9	138	136·7	19·2	198	196·1	27·6	258	255·5	35·9
19	18·8	2·6	79	78·2	11·0	139	137·7	19·3	199	197·1	27·7	259	256·5	36·0
20	19·8	2·8	80	79·2	11·1	140	138·6	19·5	200	198·1	27·8	260	257·5	36·2
21	20·8	2·9	81	80·2	11·3	141	139·6	19·6	201	199·0	28·0	261	258·5	36·3
22	21·8	3·1	82	81·2	11·4	142	140·6	19·8	202	200·0	28·1	262	259·5	36·5
23	22·8	3·2	83	82·2	11·6	143	141·6	19·9	203	201·0	28·3	263	260·4	36·6
24	23·8	3·3	84	83·2	11·7	144	142·6	20·0	204	202·0	28·4	264	261·4	36·7
25	24·8	3·5	85	84·2	11·8	145	143·6	20·2	205	203·0	28·5	265	262·4	36·9
26	25·7	3·6	86	85·2	12·0	146	144·6	20·3	206	204·0	28·7	266	263·4	37·0
27	26·7	3·8	87	86·2	12·1	147	145·6	20·5	207	205·0	28·8	267	264·4	37·2
28	27·7	3·9	88	87·1	12·2	148	146·6	20·6	208	206·0	28·9	268	265·4	37·3
29	28·7	4·0	89	88·1	12·4	149	147·5	20·7	209	207·0	29·1	269	266·4	37·4
30	29·7	4·2	90	89·1	12·5	150	148·5	20·9	210	208·0	29·2	270	267·4	37·6
31	30·7	4·3	91	90·1	12·7	151	149·5	21·0	211	208·9	29·4	271	268·4	37·7
32	31·7	4·5	92	91·1	12·8	152	150·5	21·2	212	209·9	29·5	272	269·4	37·9
33	32·7	4·6	93	92·1	12·9	153	151·5	21·3	213	210·9	29·6	273	270·3	38·0
34	33·7	4·7	94	93·1	13·1	154	152·5	21·4	214	211·9	29·8	274	271·3	38·1
35	34·7	4·9	95	94·1	13·2	155	153·5	21·6	215	212·9	29·9	275	272·3	38·3
36	35·6	5·0	96	95·1	13·4	156	154·5	21·7	216	213·9	30·1	276	273·3	38·4
37	36·6	5·1	97	96·1	13·5	157	155·5	21·9	217	214·9	30·2	277	274·3	38·6
38	37·6	5·3	98	97·0	13·6	158	156. 5	22·0	218	215·9	30·3	278	275·3	38·7
39	38·6	5·5	99	98·0	13·8	159	157. 5	22·1	219	216·9	30·5	279	276·3	38·8
40	39·6	5·6	100	99·0	13·9	160	158·4	22·3	220	217·9	30·6	280	277·3	39·0
41	40·6	5·7	101	100·0	14·1	161	159·4	22·4	221	218·8	30·8	281	278·3	39·1
42	41·6	5·8	102	101·0	14·2	162	160·4	22·5	222	219·8	30·9	282	279·3	39·2
43	42·6	6·0	103	102·0	14·3	163	161·4	22·7	223	220·8	31·0	283	280·2	39·4
44	43·6	6·1	104	103·0	14·5	164	162·4	22·8	224	221·8	31·2	284	281·2	39·5
45	44·6	6·3	105	104·0	14·6	165	163·4	23·0	225	222·8	31·3	285	282·2	39·7
46	45·6	6·4	106	105·0	14·8	166	164·4	23·1	226	223·8	31·5	286	283·2	39·8
47	46·5	6·5	107	106·0	14·9	167	165·4	23·2	227	224·8	31·6	287	284·2	39·9
48	47·5	6·7	108	106·9	15·0	168	166·4	23·4	228	225·8	31·7	288	285·2	40·1
49	48·5	6·8	109	107·9	15·2	169	167·4	23·5	229	226·8	31·9	289	286·2	40·2
50	49·5	7·0	110	108·9	15·3	170	168·3	23·7	230	227·8	32·0	290	287·2	40·4
51	50·5	7·1	111	109·9	15·4	171	169·3	23·8	231	228·8	32·1	291	288·2	40·5
52	51·5	7·2	112	110·9	15·6	172	170·3	23·9	232	229·7	32·3	292	289·2	40·6
53	52·5	7·4	113	111·9	15·7	173	171·3	24·1	233	230·7	32·4	293	290·1	40·8
54	53·5	7·5	114	112·9	15·9	174	172·3	24·2	234	231·7	32·6	294	291·1	40·9
55	54·5	7·7	115	113·9	16·0	175	173·3	24·4	235	232·7	32·7	295	292·1	41·1
56	55·5	7·8	116	114·9	16·1	176	174·3	24·5	236	233·7	32·8	296	293·1	41·2
57	56·4	7·9	117	115·9	16·3	177	175·3	24·6	237	234·7	33. 0	297	294·1	41·3
58	57·4	8·1	118	116·9	16·4	178	176·3	24·8	238	235·7	33·1	298	295·1	41·5
59	58·4	8·2	119	117·8	16·6	179	177·3	24·9	239	236·7	33·3	299	296·1	41·6
60	59·4	8·4	120	118·8	16·7	180	178·3	25·1	240	237·7	33·4	300	297·1	41·8
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

TABLE 2.

Traverse Table to 9 Degrees = 0h. 36m.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	1·0	0·2	61	60·2	9·5	121	119·5	18·9	181	178·8	28·3	241	238·0	37·7
2	2·0	0·3	62	61·2	9·7	122	120·5	19·1	182	179·8	28·5	242	239·0	37·9
3	3·0	0·5	63	62·2	9·9	123	121·5	19·2	183	180·7	28·6	243	240·0	38·0
4	4·0	0·6	64	63·2	10·0	124	122·5	19·4	184	181·7	28·8	244	241·0	38·2
5	4·9	0·8	65	64·2	10·2	125	123·5	19·6	185	182·7	28·9	245	242·0	38·3
6	5·9	0·9	66	65·2	10·3	126	124·4	19·7	186	183·7	29·1	246	243·0	38·5
7	6·9	1·1	67	66·2	10·5	127	125·4	19·9	187	184·7	29·3	247	244·0	38·6
8	7·9	1·3	68	67·2	10·6	128	126·4	20·0	188	185·7	29·4	248	244·9	38·8
9	8·9	1·4	69	68·2	10·8	129	127·4	20·2	189	186·7	29·6	249	245·9	39·0
10	9·9	1·6	70	69·1	11·0	130	128·4	20·3	190	187·7	29·7	250	246·9	39·1
11	10·9	1·7	71	70·1	11·1	131	129·4	20·5	191	188·6	29·9	251	247·9	39·3
12	11·9	1·9	72	71·1	11·3	132	130·4	20·6	192	189·6	30·0	252	248·9	39·4
13	12·8	2·0	73	72·1	11·4	133	131·4	20·8	193	190·6	30·2	253	249·9	39·6
14	13·8	2·2	74	73·1	11·6	134	132·4	21·0	194	191·6	30·3	254	250·9	39·7
15	14·8	2·3	75	74·1	11·7	135	133·3	21·1	195	192·6	30·5	255	251·9	39·9
16	15·8	2·5	76	75·1	11·9	136	134·3	21·3	196	193·6	30·7	256	252·8	40·0
17	16·8	2 7	77	76·1	12·0	137	135·3	21·4	197	194·6	30·8	257	253·8	40·2
18	17·8	2·8	78	77·0	12·2	138	136·3	21·6	198	195·6	31·0	258	254·8	40·4
19	18·8	3·0	79	78·0	12·4	139	137·3	21·7	199	196·5	31·1	259	255·8	40·5
20	19·8	3·1	80	79·0	12·5	140	138·3	21·9	200	197·5	31·3	260	256·8	40·7
21	20·7	3·3	81	80·0	12·7	141	139·3	22·1	201	198·5	31·4	261	257·8	40·8
22	21·7	3·4	82	81·0	12·8	142	140·3	22·2	202	199·5	31·6	262	258·8	41·0
23	22·7	3·6	83	82·0	13·0	143	141·2	22·4	203	200·5	31·8	263	259·8	41·1
24	23·7	3·8	84	83·0	13·1	144	142·2	22·5	204	201·5	31·9	264	260·7	41·3
25	24·7	3·9	85	84·0	13·3	145	143·2	22·7	205	202·5	32·1	265	261·7	41·5
26	25·7	4·1	86	84·9	13·5	146	144·2	22·8	206	203·5	32·2	266	262·7	41·6
27	26·7	4·2	87	85·9	13·6	147	145·2	23·0	207	204·5	32·4	267	263·7	41·8
28	27·7	4·4	88	86·9	13·8	148	146·2	23·2	208	205·4	32·5	268	264·7	41·9
29	28·6	4·5	89	87·9	13·9	149	147·2	23·3	209	206·4	32·7	269	265·7	42·1
30	29·6	4·7	90	88·9	14·1	150	148·2	23·5	210	207·4	32·9	270	266·7	42·2
31	30·6	4·8	91	89·9	14·2	151	149·1	23·6	211	208·4	33·0	271	267·7	42·4
32	31·6	5·0	92	90·9	14·4	152	150·1	23·8	212	209·4	33·2	272	268·7	42·6
33	32·6	5·2	93	91·9	14·5	153	151·1	23·9	213	210·4	33·3	273	269·7	42·7
34	33·6	5·3	94	92·8	14·7	154	152·1	24·1	214	211·4	33·5	274	270·6	42·9
35	34·6	5·5	95	93·8	14·9	155	153·1	24·2	215	212·4	33·6	275	271·6	43·0
36	35·6	5·6	96	94·8	15·0	156	154·1	24·4	216	213·3	33·8	276	272·6	43·2
37	36·5	5·8	97	95·8	15·2	157	155·1	24·6	217	214·3	33·9	277	273·6	43·3
38	37·5	5·9	98	96·8	15·3	158	156·1	24·7	218	215·3	34·1	278	274·6	43·5
39	38·5	6·1	99	97·8	15·5	159	157·0	24·9	219	216·3	34·3	279	275·6	43·6
40	39·5	6·3	100	98·8	15·6	160	158·0	25·0	220	217·3	34·4	280	276·6	43·8
41	40·5	6·4	101	99·8	15·8	161	159·0	25·2	221	218·3	34·6	281	277·5	44·0
42	41·5	6·6	102	100·7	16·0	162	160·0	25·3	222	219·3	34·7	282	278·5	44·1
43	42·5	6·7	103	101·7	16·1	163	161·0	25·5	223	220·3	34·9	283	279·5	44·3
44	43·5	6·9	104	102·7	16·3	164	162·0	25·7	224	221·2	35·0	284	280·5	44·4
45	44·4	7·0	105	103·7	16·4	165	163·0	25·8	225	222·2	35.2	285	281·5	44·6
46	45·4	7·2	106	104·7	16·6	166	164·0	26·0	226	223·2	35·4	286	282·5	44·7
47	46·4	7·4	107	105·7	16·7	167	164·9	26·1	227	224·2	35·5	287	283·5	44·9
48	47·4	7·5	108	106·7	16·9	168	165·9	26·3	228	225·2	35·7	288	284·5	45·1
49	48·4	7·7	109	107·7	17·1	169	166·9	26·4	229	226·2	35·8	289	285·4	45·2
50	49·4	7·8	110	108·6	17·2	170	167·9	26·6	230	227·2	36·0	290	286·4	45·4
51	50·4	8·0	111	109·6	17·4	171	168·9	26·8	231	228·2	36·1	291	287·4	45·5
52	51·4	8·1	112	110·6	17·5	172	169·9	26·9	232	229·1	36·3	292	288·4	45·7
53	52·3	8·3	113	111·6	17·7	173	170·9	27·1	233	230·1	36·4	293	289·4	45·8
54	53·3	8·4	114	112·6	17·8	174	171·9	27·2	234	231·1	36·6	294	290·4	46·0
55	54·3	8·6	115	113·6	18·0	175	172·8	27·4	235	232·1	36·8	295	291·4	46·1
56	55·3	8·8	116	114·6	18·1	176	173·8	27·5	236	233·1	36·9	296	292·4	46·3
57	56·3	8·9	117	115·6	18·3	177	174·8	27·7	237	234·1	37·1	297	293·4	46·5
58	57·3	9·1	118	116·5	18·5	178	175·8	27·8	238	235·1	37·2	298	294·3	46·6
59	58·3	9·2	119	117·5	18·6	179	176·8	28·0	239	236·1	37·4	299	295·3	46·8
60	59·3	9·4	120	118·5	18·8	180	177·8	28·2	240	237·0	37·5	300	296·3	46·9
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

TABLE 2.

Traverse Table to 10 Degrees = 0h. 40m.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	1·0	0·2	61	60·1	10·6	121	119·2	21·0	181	178·3	31·4	241	237·3	41·8
2	2·0	0·3	62	61·1	10·8	122	120·1	21·2	182	179·2	31·6	242	238·3	42·0
3	3·0	0·5	63	62·0	10·9	123	121·1	21·4	183	180·2	31·8	243	239·3	42·2
4	3·9	0·7	64	63·0	11·1	124	122·1	21·5	184	181·2	32·0	244	240·3	42·4
5	4·9	0·9	65	64·0	11·3	125	123·1	21·7	185	182·2	32·1	245	241·3	42.5
6	5·9	1·0	66	65·0	11·5	126	124·1	21·9	186	183·2	32·3	246	242·3	42.7
7	6·9	1·2	67	66·0	11·6	127	125.1	22·1	187	184·2	32·5	247	243·2	42·9
8	7·9	1·4	68	67·0	11·8	128	126·1	22·2	188	185·1	32·6	248	244·2	43·1
9	8·9	1·6	69	68·0	12·0	129	127·0	22·4	189	186·1	32·8	249	245·2	43·2
10	9·8	1·7	70	68·9	12·2	130	128·0	22·6	190	187·1	33·0	250	246·2	43·4
11	10·8	1·9	71	69·9	12·3	131	129·0	22·7	191	188·1	33·2	251	247·2	43·6
12	11·8	2·1	72	70·9	12·5	132	130·0	22·9	192	189·1	33·3	252	248·2	43·8
13	12·8	2·3	73	71·9	12·7	133	131·0	23·1	193	190·1	33·5	253	249·2	43·9
14	13·8	2·4	74	72·9	12·8	134	132·0	23·3	194	191·1	33·7	254	250·1	44·1
15	14·8	2·6	75	73·9	13·0	135	132·9	23·4	195	192·0	33·9	255	251·1	44·3
16	15·8	2·8	76	74·8	13·2	136	133·9	23·6	196	193·0	34·0	256	252·1	44·5
17	16·7	3·0	77	75·8	13·4	137	134·9	23·8	197	194·0	34·2	257	253·1	44·6
18	17·7	3·1	78	76·8	13·5	138	135·9	24·0	198	195·0	34·4	258	254·1	44·8
19	18·7	3·3	79	77·8	13·7	139	136·9	24·1	199	196·0	34·6	259	255·1	45·0
20	19·7	3·5	80	78·8	13·9	140	137·9	24·3	200	197·0	34·7	260	256·1	45·1
21	20·7	3·6	81	79·8	14·1	141	138·9	24·5	201	197·9	34·9	261	257·0	45·3
22	21·7	3·8	82	80·8	14·2	142	139·8	24·7	202	198·9	35·1	262	258·0	45·5
23	22·7	4·0	83	81·7	14·4	143	140·8	24·8	203	199·9	35·3	263	259·0	45·7
24	23·6	4·2	84	82·7	14·6	144	141·8	25·0	204	200·9	35·4	264	260·0	45·8
25	24·6	4·3	85	83·7	14·8	145	142·8	25·2	205	201·9	35·6	265	261·0	46·0
26	25·6	4·5	86	84·7	14·9	146	143·8	25·4	206	202·9	35·8	266	262·0	46·2
27	26·6	4·7	87	85·7	15·1	147	144·8	25·5	207	203·9	35·9	267	262·9	46·4
28	27·6	4·9	88	86·7	15·3	148	145·8	25·7	208	204·8	36·1	268	263·9	46·5
29	28·6	5·0	89	87·6	15·5	149	146·7	25·9	209	205·8	36·3	269	264·9	46·7
30	29·5	5·2	90	88·6	15·6	150	147·7	26·0	210	206·8	36·5	270	265·9	46·9
31	30·5	5·4	91	89·6	15·8	151	148·7	26·2	211	207·8	36·6	271	266·9	47·1
32	31·5	5·6	92	90·6	16·0	152	149·7	26·4	212	208·8	36·8	272	267·9	47·2
33	32·5	5·7	93	91·6	16·1	153	150·7	26·6	213	209·8	37·0	273	268·9	47·4
34	33·5	5·9	94	92·6	16·3	154	151·7	26·7	214	210·7	37·2	274	269·8	47·6
35	34·5	6·1	95	93·6	16·5	155	152·6	26·9	215	211·7	37·3	275	270·8	47·8
36	35·5	6·3	96	94·5	16·7	156	153·6	27·1	216	212·7	37·5	276	271·8	47·9
37	36·4	6·4	97	95·5	16·8	157	154·6	27·3	217	213·7	37·7	277	272·8	48·1
38	37·4	6·6	98	96·5	17·0	158	155·6	27·4	218	214·7	37·9	278	273·8	48.3
39	38·4	6·8	99	97·5	17·2	159	156·6	27·6	219	215·7	38·0	279	274·8	48·4
40	39·4	6·9	100	98·5	17·4	160	157·6	27·8	220	216·7	38·2	280	275·7	48·6
41	40·4	7·1	101	99·5	17·5	161	158·6	28·0	221	217·6	38·4	281	276·7	48·8
42	41·4	7·3	102	100·5	17·7	162	159·5	28·1	222	218·6	38·5	282	277·7	49·0
43	42·3	7·5	103	101·4	17·9	163	160·5	28·3	223	219·6	38·7	283	278·7	49·1
44	43.3	7·6	104	102·4	18·1	164	161·5	28·5	224	220·6	38·9	284	279·7	49·3
45	44·3	7·8	105	103·4	18·2	165	162·5	28·7	225	221·6	39·1	285	280·7	49·5
46	45·3	8·0	106	104·4	18·4	166	163·5	28·8	226	222·6	39·2	286	281·7	49·7
47	46·3	8·2	107	105·4	18·6	167	164·5	29·0	227	223·6	39·4	287	282·6	49·8
48	47·3	8·3	108	106·4	18·8	168	165·4	29·2	228	224·5	39·6	288	283·6	50·0
49	48·3	8·5	109	107·3	18·9	169	166·4	29·3	229	225·5	39·8	289	284·6	50·2
50	49·2	8·7	110	108·3	19·1	170	167·4	29·5	230	226·5	39·9	290	285·6	50·4
51	50·2	8·9	111	109·3	19·3	171	168·4	29·7	231	227·5	40·1	291	286·6	50·5
52	51·2	9·0	112	110·3	19·4	172	169·4	29·9	232	228·5	40·3	292	287·6	50·7
53	52·2	9·2	113	111·3	19·6	173	170·4	30·0	233	229·5	40·5	293	288·5	50·9
54	53·2	9·4	114	112·3	19·8	174	171·4	30·2	234	230·4	40·6	294	289·5	51·1
55	54·2	9·6	115	113·3	20·0	175	172·3	30·4	235	231·4	40·8	295	290·5	51·2
56	55·1	9·7	116	114·2	20·1	176	173·3	30·6	236	232·4	41·0	296	291·5	51·4
57	56·1	9·9	117	115·2	20·3	177	174·3	30·7	237	233·4	41·2	297	292·5	51·6
58	57·1	10·1	118	116·2	20·5	178	175·3	30·9	238	234·4	41·3	298	293·5	51·7
59	58·1	10·2	119	117·2	20·7	179	176·3	31·1	239	235·4	41·5	299	294·5	51·9
60	59·1	10·4	120	118·2	20·8	180	177·3	31·3	240	236·4	41·7	300	295·4	52·1
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

TABLE 2.

Traverse Table to 11 Degrees = 0h. 44m.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	1·0	0·2	61	59·9	11·6	121	118·8	23·1	181	177·7	34·5	241	236·6	46·0
2	2·0	0·4	62	60·9	11·8	122	119·8	23·3	182	178·7	34·7	242	237·6	46·2
3	2·9	0·6	63	61·8	12·0	123	120·7	23·5	183	179·6	34·9	243	238·5	46·4
4	3·9	0·8	64	62·8	12·2	124	121·7	23·7	184	180·6	35·1	244	239·5	46·6
5	4·9	1·0	65	63·8	12·4	125	122·7	23·9	185	181·6	35·3	245	240·5	46·7
6	5·9	1·1	66	64·8	12·6	126	123·7	24·0	186	182·6	35·5	246	241·5	46·9
7	6·9	1·3	67	65·8	12·8	127	124·7	24·2	187	183·6	35·7	247	242·5	47·1
8	7·9	1·5	68	66·8	13·0	128	125·6	24·4	188	184·5	35·9	248	243·4	47·3
9	8·8	1·7	69	67·7	13·2	129	126·6	24·6	189	185·5	36·1	249	244·4	47·5
10	9·8	1·9	70	68·7	13·4	130	127·6	24·8	190	186·5	36·3	250	245·4	47·7
11	10·8	2·1	71	69·7	13·5	131	128·6	25·0	191	187·5	36·4	251	246·4	47·9
12	11·8	2·3	72	70·7	13·7	132	129·6	25·2	192	188·5	36·6	252	247·4	48·1
13	12·8	2·5	73	71·7	13·9	133	130·6	25·4	193	189·5	36·8	253	248·4	48·3
14	13·7	2·7	74	72·6	14·1	134	131·5	25·6	194	190·4	37·0	254	249·3	48·5
15	14·7	2·9	75	73·6	14·3	135	132·5	25·8	195	191·4	37·2	255	250·3	48·7
16	15·7	3·1	76	74·6	14·5	136	133·5	26·0	196	192·4	37·4	256	251·3	48·8
17	16·7	3·2	77	75·6	14·7	137	134·5	26·1	197	193·4	37·6	257	252·3	49·0
18	17·7	3·4	78	76·6	14·9	138	135·5	26·3	198	194·4	37·8	258	253·3	49·2
19	18·7	3·6	79	77·5	15·1	139	136·4	26·5	199	195·3	38·0	259	254·2	49·4
20	19·6	3·8	80	78·5	15·3	140	137·4	26·7	200	196·3	38·2	260	255·2	49·6
21	20·6	4·0	81	79·5	15·5	141	138·4	26·9	201	197·3	38·4	261	256·2	49·8
22	21·6	4·2	82	80·5	15·6	142	139·4	27·1	202	198·3	38·5	262	257·2	50·0
23	22·6	4·4	83	81·5	15·8	143	140·4	27·3	203	199·3	38·7	263	258·2	50·2
24	23·6	4·6	84	82·5	16·0	144	141·4	27·5	204	200·3	38·9	264	259·1	50·4
25	24·5	4·8	85	83.4	16·2	145	142·3	27·7	205	201·2	39·1	265	260·1	50·6
26	25·5	5·0	86	84·4	16·4	146	143·3	27·9	206	202·2	39·3	266	261·1	50·8
27	26·5	5·2	87	85·4	16·6	147	144·3	28·0	207	203·2	39·5	267	262·1	50·9
28	27·5	5·3	88	86·4	16·8	148	145·3	28·2	208	204·2	39·7	268	263·1	51·1
29	28·5	5·5	89	87·4	17·0	149	146·3	28·4	209	205·2	39·9	269	264·1	51·3
30	29·4	5·7	90	88·3	17·2	150	147·2	28·6	210	206·1	40·1	270	265·0	51·5
31	30·4	5·9	91	89·3	17·4	151	148·2	28·8	211	207·1	40·3	271	266·0	51·7
32	31·4	6·1	92	90·3	17·6	152	149·2	29·0	212	208·1	40·5	272	267·0	51·9
33	32·4	6·3	93	91·3	17·7	153	150·2	29·2	213	209·1	40·6	273	268·0	52·1
34	33·4	6·5	94	92·3	17·9	154	151·2	29·4	214	210·1	40·8	274	269·0	52·3
35	34·4	6·7	95	93·3	18·1	155	152·2	29·6	215	211·0	41·0	275	269·9	52·5
36	35·3	6·9	96	94·2	18·3	156	153·1	29·8	216	212·0	41·2	276	270·9	52·7
37	36·3	7·1	97	95·2	18·5	157	154·1	30·0	217	213·0	41·4	277	271·9	52·9
38	37·3	7·3	98	96·2	18·7	158	155·1	30·1	218	214·0	41·6	278	272·9	53·0
39	38·3	7·4	99	97·2	18·9	159	156·1	30·3	219	215·0	41·8	279	273·9	53·2
40	39·3	7·6	100	98·2	19·1	160	157·1	30 5	220	216·0	42·0	280	274·9	53·4
41	40·2	7·8	101	99·1	19·3	161	158·0	30·7	221	216·9	42·2	281	275·8	53·6
42	41·2	8·0	102	100·1	19·5	162	159·0	30·9	222	217·9	42·4	282	276·8	53·8
43	42·2	8·2	103	101·1	19·7	163	160·0	31·1	223	218·9	42·6	283	277·8	54·0
44	43·2	8·4	104	102·1	19·8	164	161·0	31·3	224	219·9	42·7	284	278·8	54·2
45	44·2	8·6	105	103·1	20·0	165	162·0	31·5	225	220·9	42·9	285	279·8	54·4
46	45·2	8·8	106	104·1	20·2	166	163·0	31·7	226	221·8	43·1	286	280·7	54·6
47	46·1	9·0	107	105·0	20·4	167	163·9	31·9	227	222·8	43·3	287	281·7	54·8
48	47·1	9·2	108	106·0	20·6	168	164·9	32·1	228	223·8	43·5	288	282·7	55·0
49	48·1	9·3	109	107·0	20·8	169	165·9	32·2	229	224·8	43·7	289	283·7	55·1
50	49·1	9·5	110	108·0	21·0	170	166·9	32·4	230	225·8	43·9	290	284·7	55·3
51	50·1	9·7	111	109·0	21·2	171	167·9	32·6	231	226·8	44·1	291	285·7	55·5
52	51·0	9·9	112	109·9	21·4	172	168·8	32·8	232	227·7	44·3	292	286·6	55·7
53	52·0	10·1	113	110·9	21·6	173	169·8	33·0	233	228·7	44·5	293	287·6	55·9
54	53·0	10·3	114	111·9	21·8	174	170·8	33·2	234	229·7	44·6	294	288·6	56·1
55	54·0	10·5	115	112·9	21·9	175	171·8	33·4	235	230·7	44·8	295	289·6	56·3
56	55·0	10·7	116	113·9	22·1	176	172·8	33·6	236	231·7	45·0	296	290·6	56·5
57	56·0	10·9	117	114·9	22·3	177	173·7	33·8	237	232·6	45·2	297	291·5	56·7
58	56·9	11·1	118	115·8	22·5	178	174·7	34·0	238	233·6	45·4	298	292·5	56·9
59	57·9	11·3	119	116·8	22·7	179	175·7	34·2	239	234·6	45·6	299	293·5	57·1
60	58·9	11·4	120	117·8	22·9	180	176·7	34·3	240	235·6	45·8	300	294·5	57·2
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

TABLE 2.

Traverse Table to 12 Degrees=0h. 48m.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	1·0	0·2	61	59·7	12·7	121	118·4	25·2	181	177·0	37·6	241	235·7	50·1
2	2·0	0·4	62	60·6	12·9	122	119·3	25·4	182	178·0	37·8	242	236·7	50·3
3	2·9	0·6	63	61·6	13·1	123	120·3	25·6	183	179·0	38·0	243	237·7	50·5
4	3·9	0·8	64	62·6	13·3	124	121·3	25·8	184	180·0	38·3	244	238·7	50·7
5	4·9	1·0	65	63·6	13·5	125	122·3	26·0	185	181·0	38·5	245	239·6	50·9
6	5·9	1·2	66	64·6	13·7	126	123·2	26·2	186	181·9	38·7	246	240·6	51·1
7	6·8	1·5	67	65·5	13·9	127	124·2	26·4	187	182·9	38·9	247	241·6	51·4
8	7·8	1·7	68	66·5	14·1	128	125·2	26·6	188	183·9	39·1	248	242·6	51·6
9	8·8	1·9	69	67·5	14·3	129	126·2	26·8	189	184·9	39·3	249	243·6	51·8
10	9·8	2·1	70	68·5	14·6	130	127·2	27·0	190	185·8	39·5	250	244·5	52·0
11	10·8	2·3	71	69·4	14·8	131	128·1	27·2	191	186·8	39·7	251	245·5	52·2
12	11·7	2·5	72	70·4	15·0	132	129·1	27·4	192	187·8	39·9	252	246·5	52·4
13	12·7	2·7	73	71·4	15·2	133	130·1	27·7	193	188·8	40·1	253	247·5	52·6
14	13·7	2·9	74	72·4	15·4	134	131·1	27·9	194	189·8	40·3	254	248·4	52·8
15	14·7	3·1	75	73·4	15·6	135	132·0	28·1	195	190·7	40·5	255	249·4	53·0
16	15·7	3·3	76	74·3	15·8	136	133·0	28·3	196	191·7	40·8	256	250·4	53·2
17	16·6	3·5	77	75·3	16·0	137	134·0	28·5	197	192·7	41·0	257	251·4	53·4
18	17·6	3·7	78	76·3	16·2	138	135·0	28·7	198	193·7	41·2	258	252·4	53·6
19	18·6	4·0	79	77·3	16·4	139	136·0	28·9	199	194·7	41·4	259	253·3	53·8
20	19·6	4·2	80	78·3	16·6	140	136·9	29·1	200	195·6	41·6	260	254·3	54·1
21	20·5	4·4	81	79·2	16·8	141	137·9	29·3	201	196·6	41·8	261	255·3	54·3
22	21·5	4·6	82	80·2	17·0	142	138·9	29·5	202	197·6	42·0	262	256·3	54·5
23	22·5	4·8	83	81·2	17·3	143	139·9	29·7	203	198·6	42·2	263	257·3	54·7
24	23·5	5·0	84	82·2	17·5	144	140·9	29·9	204	199·5	42·4	264	258·2	54·9
25	24·5	5·2	85	83·1	17·7	145	141·8	30·1	205	200·5	42·6	265	259·2	55·1
26	25·4	5·4	86	84·1	17·9	146	142·8	30·4	206	201·5	42·8	266	260·2	55·3
27	26·4	5·6	87	85·1	18·1	147	143·8	30·6	207	202·5	43·0	267	261·2	55·5
28	27·4	5·8	88	86·1	18·3	148	144·8	30·8	208	203·5	43·2	268	262·1	55·7
29	28·4	6·0	89	87·1	18·5	149	145·7	31·0	209	204·4	43·5	269	263·1	55·9
30	29·3	6·2	90	88·0	18·7	150	146·7	31·2	210	205·4	43·7	270	264·1	56·1
31	30·3	6·4	91	89·0	18·9	151	147·7	31·4	211	206·4	43·9	271	265·1	56·3
32	31·3	6·7	92	90·0	19·1	152	148·7	31·6	212	207·4	44·1	272	266·1	56·6
33	32·3	6·9	93	91·0	19·3	153	149·7	31·8	213	208·3	44·3	273	267·0	56·8
34	33·3	7·1	94	91·9	19·5	154	150·6	32·0	214	209·3	44·5	274	268·0	57·0
35	34·2	7·3	95	92·9	19·8	155	151·6	32·2	215	210·3	44·7	275	269·0	57·2
36	35·2	7·5	96	93·9	20·0	156	152·6	32·4	216	211·3	44·9	276	270·0	57·4
37	36·2	7·7	97	94·9	20·2	157	153·6	32·6	217	212·3	45·1	277	270·9	57·6
38	37·2	7·9	98	95·9	20·4	158	154·5	32·9	218	213·2	45·3	278	271·9	57·8
39	38·1	8·1	99	96·8	20·6	159	155·5	33·1	219	214·2	45·5	279	272·9	58·0
40	39·1	8·3	100	97·8	20·8	160	156·5	33·3	220	215·2	45·7	280	273·9	58·2
41	40·1	8·5	101	98·8	21·0	161	157·5	33·5	221	216·2	45·9	281	274·9	58·4
42	41·1	8·7	102	99·8	21·2	162	158·5	33·7	222	217·1	46·2	282	275·8	58·6
43	42·1	8·9	103	100·7	21·4	163	159·4	33·9	223	218·1	46·4	283	276·8	58·8
44	43·0	9·1	104	101·7	21·6	164	160·4	34·1	224	219·1	46·6	284	277·8	59·0
45	44·0	9·4	105	102·7	21·8	165	161·4	34·3	225	220·1	46·8	285	278·8	59·3
46	45·0	9·6	106	103·7	22·0	166	162·4	34·5	226	221·1	47·0	286	279·8	59·5
47	46·0	9·8	107	104·7	22·2	167	163·4	34·7	227	222·0	47·2	287	280·7	59·7
48	47·0	10·0	108	105·6	22·5	168	164·3	34·9	228	223·0	47·4	288	281·7	59·9
49	47·9	10·2	109	106·6	22·7	169	165·3	35·1	229	224·0	47·6	289	282·7	60·1
50	48·9	10·4	110	107·6	22·9	170	166·3	35·3	230	225·0	47·8	290	283·7	60·3
51	49·9	10·6	111	108·6	23·1	171	167·3	35·6	231	226·0	48·0	291	284·6	60·5
52	50·9	10·8	112	109·6	23·3	172	168·2	35·8	232	226·9	48·2	292	285·6	60·7
53	51·8	11·0	113	110·5	23·5	173	169·2	36·0	233	227·9	48·4	293	286·6	60·9
54	52·8	11·2	114	111·5	23·7	174	170·2	36·2	234	228·9	48·7	294	287·6	61·1
55	53·8	11·4	115	112·5	23·9	175	171·2	36·4	235	229·9	48·9	295	288·6	61·3
56	54·8	11·6	116	113·5	24·1	176	172·2	36·6	236	230·8	49·1	296	289·5	61·5
57	55·8	11·9	117	114·4	24·3	177	173·1	36·8	237	231·8	49·3	297	290·5	61·7
58	56·7	12·1	118	115·4	24·5	178	174·1	37·0	238	232·8	49·5	298	291·5	62·0
59	57·7	12·3	119	116·4	24·7	179	175·1	37·2	239	233·8	49·7	299	292·5	62·2
60	58·7	12·5	120	117·4	24·9	180	176·1	37·4	240	234·8	49·9	300	293·4	62·4
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

78° = 5h. 12m.

Traverse Table to 13 Degrees = 0h. 52m

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	1·0	0·2	61	59·4	13·7	121	117·9	27·2	181	176·4	40·7	241	234·8	54·2
2	1·9	0·4	62	60·4	13·9	122	118·9	27·4	182	177·3	40·9	242	235·8	54·4
3	2·9	0·7	63	61·4	14·2	123	119·8	27·7	183	178·3	41·2	243	236·8	54·7
4	3·9	0·9	64	62·4	14·4	124	120·8	27·9	184	179·3	41·4	244	237·7	54·9
5	4·9	1·1	65	63·3	14·6	125	121·8	28·1	185	180·3	41·6	245	238·7	55·1
6	5·8	1·3	66	64·3	14·8	126	122·8	28·3	186	181·2	41·8	246	239·7	55·3
7	6·8	1·6	67	65·3	15·1	127	123·7	28·6	187	182·2	42·1	247	240·7	55·6
8	7·8	1·8	68	66·3	15·3	128	124·7	28·8	188	183·2	42·3	248	241·6	55·8
9	8·8	2·0	69	67·2	15·5	129	125·7	29·0	189	184·2	42·5	249	242·6	56·0
10	9·7	2·2	70	68·2	15·7	130	126·7	29·2	190	185·1	42·7	250	243·6	56·2
11	10·7	2·5	71	69·2	16·0	131	127·6	29·5	191	186·1	43·0	251	244·6	56·5
12	11·7	2·7	72	70·2	16·2	132	128·6	29·7	192	187·1	43·2	252	245·5	56·7
13	12·7	2·9	73	71·1	16·4	133	129·6	29·9	193	188·1	43·4	253	246·5	56·9
14	13·6	3·1	74	72·1	16·6	134	130·6	30·1	194	189·0	43·6	254	247·5	57·1
15	14·6	3·4	75	73·1	16·9	135	131·5	30·4	195	190·0	43·9	255	248·5	57·4
16	15·6	3·6	76	74·1	17·1	136	132·5	30·6	196	191·0	44·1	256	249·4	57·6
17	16·6	3·8	77	75·0	17·3	137	133·5	30·8	197	192·0	44·3	257	250·4	57·8
18	17·5	4·0	78	76·0	17·5	138	134·5	31·0	198	192·9	44·5	258	251·4	58·0
19	18·5	4·3	79	77·0	17·8	139	135·4	31·3	199	193·9	44·8	259	252·4	58·3
20	19·5	4·5	80	77·9	18·0	140	136·4	31·5	200	194·9	45·0	260	253·3	58·5
21	20·5	4·7	81	78·9	18·2	141	137·4	31·7	201	195·8	45·2	261	254·3	58·7
22	21·4	4·9	82	79·9	18·4	142	138·4	31·9	202	196·8	45·4	262	255·3	58·9
23	22·4	5·2	83	80·9	18·7	143	139·3	32·2	203	197·8	45·7	263	256·3	59·2
24	23·4	5·4	84	81·8	18·9	144	140·3	32·4	204	198·8	45·9	264	257·2	59·4
25	24·4	5·6	85	82·8	19·1	145	141·3	32·6	205	199·7	46·1	265	258·2	59·6
26	25·3	5·8	86	83·8	19·3	146	142·3	32·8	206	200·7	46·3	266	259·2	59·8
27	26·3	6·1	87	84·8	19·6	147	143·2	33·1	207	201·7	46·5	267	260·2	60·1
28	27·3	6·3	88	85·7	19·8	148	144·2	33·3	208	202·7	46·8	268	261·1	60·3
29	28·3	6·5	89	86·7	20·0	149	145·2	33·5	209	203·6	47·0	269	262·1	60·5
30	29·2	6·7	90	87·7	20·2	150	146·2	33·7	210	204·6	47·2	270	263·1	60·7
31	30·2	7·0	91	88·7	20·5	151	147·1	34·0	211	205·6	47·4	271	264·1	61·0
32	31·2	7·2	92	89·6	20·7	152	148·1	34·2	212	206·6	47·7	272	265·0	61·2
33	32·2	7·4	93	90·6	20·9	153	149·1	34·4	213	207·5	47·9	273	266·0	61·4
34	33·1	7·6	94	91·6	21·1	154	150·1	34·6	214	208·5	48·1	274	267·0	61·6
35	34·1	7·9	95	92·6	21·4	155	151·0	34·9	215	209·5	48·4	275	268·0	61·9
36	35·1	8·1	96	93·5	21·6	156	152·0	35·1	216	210·5	48·6	276	268·9	62·1
37	36·1	8·3	97	94·5	21·8	157	153·0	35·3	217	211·4	48·8	277	269·9	62·3
38	37·0	8.5	98	95·5	22·0	158	154·0	35·5	218	212·4	49·0	278	270·9	62·5
39	38·0	8·8	99	96·5	22·3	159	154·9	35·8	219	213·4	49·3	279	271·8	62·8
40	39·0	9·0	100	97·4	22·5	160	155·9	36·0	220	214·4	49·5	280	272·8	63·0
41	39·9	9·2	101	98·4	22·7	161	156·9	36·2	221	215·3	49·7	281	273·8	63·2
42	40·9	9·4	102	99·4	22·9	162	157·8	36·4	222	216·3	49·9	282	274·8	63·4
43	41·9	9·7	103	100·4	23·2	163	158·8	36·7	223	217·3	50·2	283	275·7	63·7
44	42·9	9·9	104	101·3	23·4	164	159·8	36·9	224	218·3	50·4	284	276·7	63·9
45	43·8	10·1	105	102·3	23·6	165	160·8	37·1	225	219·2	50·6	285	277·7	64·1
46	44·8	10·3	106	103·3	23·8	166	161·7	37·3	226	220·2	50·8	286	278·7	64·3
47	45·8	10·6	107	104·3	24·1	167	162·7	37·6	227	221·2	51·1	287	279·6	64·6
48	46·8	10·8	108	105·2	24·3	168	163·7	37·8	228	222·2	51·3	288	280·6	64·8
49	47·7	11·0	109	106·2	24·5	169	164·7	38·0	229	223·1	51·5	289	281·6	65·0
50	48·7	11·2	110	107·2	24·7	170	165·6	38·2	230	224·1	51·7	290	282·6	65·2
51	49·7	11·5	111	108·2	25·0	171	166·6	38·5	231	225·1	52·0	291	283·5	65·5
52	50·7	11·7	112	109·1	25·2	172	167·6	38·7	232	226·1	52·2	292	284·5	65·7
53	51·6	11·9	113	110·1	25·4	173	168·6	38·9	233	227·0	52·4	293	285·5	65·9
54	52·6	12·1	114	111·1	25·6	174	169·5	39·1	234	228·0	52·6	294	286·5	66·1
55	53·6	12·4	115	112·1	25·9	175	170·5	39·4	235	229·0	52·9	295	287·4	66·4
56	54·6	12·6	116	113·0	26·1	176	171·5	39·6	236	230·0	53·1	296	288·4	66·6
57	55·5	12·8	117	114·0	26·3	177	172·5	39·8	237	230·9	53·3	297	289·4	66·8
58	56·5	13·0	118	115·0	26·5	178	173·4	40·0	238	231·9	53·5	298	290·4	67·0
59	57·5	13·3	119	116·0	26·8	179	174·4	40·3	239	232·9	53·8	299	291·3	67·3
60	58·5	13·5	120	116·9	27·0	180	175·4	40·5	240	233·8	54·0	300	292·3	67·5
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

77° = 5h. 8m.

TABLE 2.

Traverse Table to 14 Degrees = 0h. 56m.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	1·0	0·2	61	59·2	14·8	121	117·4	29·3	181	175·6	43·8	241	233·8	58·3
2	1·9	0·5	62	60·2	15·0	122	118·4	29·5	182	176·6	44·0	242	234·8	58·5
3	2·9	0·7	63	61·1	15·2	123	119·3	29·8	183	177·6	44·3	243	235·8	58·8
4	3·9	1·0	64	62·1	15·5	124	120·3	30·0	184	178·5	44·5	244	236·8	59·0
5	4·9	1·2	65	63·1	15·7	125	121·3	30·2	185	179·5	44·8	245	237·7	59·3
6	5·8	1·5	66	64·0	16·0	126	122·3	30·5	186	180·5	45·0	246	238·7	59·5
7	6·8	1·7	67	65·0	16·2	127	123·2	30·7	187	181·4	45·2	247	239·7	59·8
8	7·8	1·9	68	66·0	16·5	128	124·2	31·0	188	182·4	45·5	248	240·6	60·0
9	8·7	2·2	69	67·0	16·7	129	125·2	31·2	189	183·4	45·7	249	241·6	60·2
10	9·7	2·4	70	67·9	16·9	130	126·1	31·4	190	184·4	46·0	250	242·6	60·5
11	10·7	2·7	71	68·9	17·2	131	127·1	31·7	191	185·3	46·2	251	243·5	60·7
12	11·6	2·9	72	69·9	17·4	132	128·1	31·9	192	186·3	46·4	252	244·5	61·0
13	12·6	3·1	73	70·8	17·7	133	129·0	32·2	193	187·3	46·7	253	245·5	61·2
14	13·6	3·4	74	71·8	17·9	134	130·0	32·4	194	188·2	46·9	254	246·5	61·4
15	14·6	3·6	75	72·8	18·1	135	131·0	32·7	195	189·2	47·2	255	247·4	61·7
16	15·5	3·9	76	73·7	18·4	136	132·0	32·9	196	190·2	47·4	256	248·4	61·9
17	16·5	4·1	77	74·7	18·6	137	132·9	33·1	197	191·1	47·7	257	249·4	62·2
18	17·5	4·4	78	75·7	18·9	138	133·9	33·4	198	192·1	47·9	258	250·3	62·4
19	18·4	4·6	79	76·7	19·1	139	134·9	33·6	199	193·1	48·1	259	251·3	62·7
20	19·4	4·8	80	77·6	19·4	140	135·8	33·9	200	194·1	48·4	260	252·3	62·9
21	20·4	5·1	81	78·6	19·6	141	136·8	34·1	201	195·0	48·6	261	253·2	63·1
22	21·3	5·3	82	79·6	19·8	142	137·8	34·4	202	196·0	48·9	262	254·2	63·4
23	22·3	5·6	83	80·5	20·1	143	138·8	34·6	203	197·0	49·1	263	255·2	63·6
24	23·3	5·8	84	81·5	20·3	144	139·7	34·8	204	197·9	49·4	264	256·2	63·9
25	24·3	6·0	85	82·5	20·6	145	140·7	35·1	205	198·9	49·6	265	257·1	64·1
26	25·2	6·3	86	83·4	20·8	146	141·7	35·3	206	199·9	49·8	266	258·1	64·4
27	26·2	6·5	87	84·4	21·0	147	142·6	35·6	207	200·9	50·1	267	259·1	64·6
28	27·2	6·8	88	85·4	21·3	148	143·6	35·8	208	201·8	50·3	268	260·0	64·8
29	28·1	7·0	89	86·3	21·5	149	144·6	36·0	209	202·8	50·6	269	261·0	65·1
30	29·1	7·3	90	87·3	21·8	150	145·5	36·3	210	203·8	50·8	270	262·0	65·3
31	30·1	7·5	91	88·3	22·0	151	146·5	36·5	211	204·7	51·0	271	263·0	65·6
32	31·0	7·7	92	89·3	22·3	152	147·5	36·8	212	205·7	51·3	272	263·9	65·8
33	32·0	8·0	93	90·2	22·5	153	148·5	37·0	213	206·7	51·5	273	264·9	66·0
34	33·0	8·2	94	91·2	22·7	154	149·4	37·3	214	207·6	51·8	274	265·9	66·3
35	34·0	8·5	95	92·2	23·0	155	150·4	37.5	215	208·6	52·0	275	266·8	66·6
36	34·9	8·7	96	93·1	23·2	156	151·4	37·7	216	209·6	52·3	276	267·8	66·8
37	35·9	9·0	97	94·1	23·5	157	152·3	38·0	217	210·6	52·5	277	268·8	67·0
38	36·9	9·2	98	95·1	23·7	158	153·3	38·2	218	211·5	52·7	278	269·7	67·3
39	37·8	9·4	99	96·1	24·0	159	154·3	38·5	219	212·5	53·0	279	270·7	67·5
40	38·8	9·7	100	97·0	24·2	160	155·2	38·7	220	213·5	53·2	280	271·7	67·7
41	39·8	9·9	101	98·0	24·4	161	156·2	38·9	221	214·4	53·5	281	272·7	68·0
42	40·8	10·2	102	99·0	24·7	162	157·2	39·2	222	215·4	53·7	282	273·6	68·2
43	41·7	10·4	103	99·9	24·9	163	158·2	39·4	223	216·4	53·9	283	274·6	68·5
44	42·7	10·6	104	100·9	25·2	164	159·1	39·7	224	217·3	54·2	284	275·6	68·7
45	43·7	10·9	105	101·9	25·4	165	160·1	39·9	225	218·3	54·4	285	276·5	68·9
46	44·6	11·1	106	102·9	25·6	166	161·1	40·2	226	219·3	54·7	286	277·5	69·2
47	45·6	11·4	107	103·8	25·9	167	162·0	40·4	227	220·3	54·9	287	278·5	69·4
48	46·6	11·6	108	104·8	26·1	168	163·0	40·6	228	221·2	55·2	288	279·4	69·7
49	47·5	11·9	109	105·8	26·4	169	164·0	40·9	229	222·2	55·4	289	280·4	69·9
50	48·5	12·1	110	106·7	26·6	170	165·0	41·1	230	223·2	55·6	290	281·4	70·2
51	49·5	12·3	111	107·7	26·9	171	165·9	41·4	231	224·1	55·9	291	282·4	70·4
52	50·5	12·6	112	108·7	27·1	172	166·9	41·6	232	225·1	56·1	292	283·3	70·6
53	51·4	12·8	113	109·6	27·3	173	167·9	41·9	233	226·1	56·4	293	284·3	70·9
54	52·4	13·1	114	110·6	27·6	174	168·8	42·1	234	227·0	56·6	294	285·3	71·1
55	53·4	13·3	115	111·6	27·8	175	169·8	42·3	235	228·0	56·9	295	286·2	71·4
56	54·3	13·5	116	112·6	28·1	176	170·8	42·6	236	229·0	57·1	296	287·2	71·6
57	55·3	13·8	117	113·5	28·3	177	171·7	42·8	237	230·0	57·3	297	288·2	71·9
58	56·3	14·0	118	114·5	28·6	178	172·7	43·1	238	230·9	57·6	298	289·1	72·1
59	57·2	14·3	119	115·5	28·8	179	173·7	43·3	239	231·9	57·8	299	290·1	72·3
60	58·2	14·5	120	116·4	29·0	180	174·7	43·5	240	232·9	58·1	300	291·1	72·6
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

76° = 5h. 4m.

TABLE 2.

Traverse Table to 15 Degrees = 1h. 0m.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	1·0	0·3	61	58·9	15·8	121	116·9	31·3	181	174·8	46·8	241	232·8	62·4
2	1·9	0·5	62	59·9	16·0	122	117·8	31·6	182	175·8	47·1	242	233·8	62·6
3	2·9	0·8	63	60·9	16·3	123	118·8	31·8	183	176·8	47·4	243	234·7	62·9
4	3·9	1·0	64	61·8	16·6	124	119·8	32·1	184	177·7	47·6	244	235·7	63·2
5	4·8	1·3	65	62·8	16·8	125	120·7	32·4	185	178·7	47·9	245	236·7	63·4
6	5·8	1·6	66	63·8	17·1	126	121·7	32·6	186	179·7	48·1	246	237·6	63·7
7	6·8	1·8	67	64·7	17·3	127	122·7	32·9	187	180·6	48·4	247	238·6	63·9
8	7·7	2·1	68	65·7	17·6	128	123·6	33·1	188	181·6	48·7	248	239·5	64·2
9	8·7	2·3	69	66·6	17·9	129	124·6	33·4	189	182·6	48·9	249	240·5	64·4
10	9·7	2·6	70	67·6	18·1	130	125·6	33·6	190	183·5	49·2	250	241·5	64·7
11	10·6	2·8	71	68·6	18·4	131	126·5	33·9	191	184·5	49·4	251	242·4	65·0
12	11·6	3·1	72	69·5	18·6	132	127·5	34·2	192	185·5	49·7	252	243·4	65·2
13	12·6	3·4	73	70·5	18·9	133	128·5	34·4	193	186·4	50·0	253	244·4	65·5
14	13·5	3·6	74	71·5	19·2	134	129·4	34·7	194	187·4	50·2	254	245·3	65·7
15	14·5	3·9	75	72·4	19·4	135	130·4	34·9	195	188·4	50·5	255	246·3	66·0
16	15·5	4.1	76	73·4	19·7	136	131·4	35·2	196	189·3	50·7	256	247·3	66·3
17	16·4	4·4	77	74·4	19·9	137	132·3	35·5	197	190·3	51·0	257	248·2	66·5
18	17·4	4·7	78	75·3	20·2	138	133·3	35·7	198	191·3	51·2	258	249·2	66·8
19	18·4	4·9	79	76·3	20·4	139	134·3	36·0	199	192·2	51·5	259	250·2	67·0
20	19·3	5·2	80	77·3	20·7	140	135·2	36·2	200	193·2	51.8	260	251·1	67·3
21	20·3	5·4	81	78·2	21·0	141	136·2	36·5	201	194·2	52·0	261	252·1	67·6
22	21·3	5·7	82	79·2	21·2	142	137·2	36·8	202	195·1	52·3	262	253·1	67·8
23	22·2	6·0	83	80·2	21·5	143	138·1	37·0	203	196·1	52·5	263	254·0	68·1
24	23·2	6·2	84	81·1	21·7	144	139·1	37·3	204	197·0	52·8	264	255·0	68·3
25	24·1	6·5	85	82·1	22·0	145	140·1	37·5	205	198·0	53·1	265	256·0	68·6
26	25·1	6·7	86	83·1	22·3	146	141·0	37·8	206	199·0	53·3	266	256·9	68·8
27	26·1	7·0	87	84·0	22·5	147	142·0	38·0	207	199·9	53·6	267	257·9	69·1
28	27·0	7·2	88	85·0	22·8	148	143·0	38·3	208	200·9	53·8	268	258·9	69·4
29	28·0	7·5	89	86·0	23·0	149	143·9	38·6	209	201·9	54·1	269	259·8	69·6
30	29·0	7·8	90	86·9	23·3	150	144·9	38·8	210	202·8	54·4	270	260·8	69·9
31	29·9	8·0	91	87·9	23·6	151	145·9	39·1	211	203·8	54·6	271	261·8	70·1
32	30·9	8·3	92	88·9	23·8	152	146·8	39·3	212	204·8	54·9	272	262·7	70·4
33	31.9	·5	93	89·8	24·1	153	147·8	39·6	213	205·7	55·1	273	263·7	70·7
34	32.8	8·8	94	90·8	24·3	154	148·8	39·9	214	206·7	55·4	274	264·7	70·9
35	33·8	9·1	95	91·8	24·6	155	149·7	40·1	215	207·7	55·6	275	265·6	71·2
36	34·8	9·3	96	92·7	24·8	156	150·7	40·4	216	208·6	55·9	276	266·6	71·4
37	35·7	9·6	97	93·7	25·1	157	151·7	40·6	217	209·6	56·2	277	267·6	71·7
38	36·7	9·8	98	94·7	25·4	158	152·6	40·9	218	210·6	56·4	278	268·5	72·0
39	37·7	10·1	99	95·6	25·6	159	153·6	41·2	219	211·5	56·7	279	269·5	72·2
40	38·6	10·4	100	96·6	25·9	160	154·5	41·4	220	212·5	56·9	280	270·5	72·5
41	39·6	10·6	101	97·6	26·1	161	155·5	41·7	221	213·5	57·2	281	271·4	72·7
42	40·6	10·9	102	98·5	26·4	162	156·5	41·9	222	214·4	57·5	282	272·4	73·0
43	41·5	11·1	103	99·5	26·7	163	157·4	42·2	223	215·4	57·7	283	273·4	73·2
44	42·5	11·4	104	100·5	26·9	164	158·4	42·4	224	216·4	58·0	284	274·3	73·5
45	43·5	11·6	105	101·4	27·2	165	159·4	42·7	225	217·3	58·2	285	275·3	73·8
46	44·4	11·9	106	102·4	27·4	166	160·3	43·0	226	218·3	58·5	286	276·3	74·0
47	45·4	12·2	107	103·4	27·7	167	161·3	43·2	227	219·3	58·8	287	277·2	74·3
48	46·4	12·4	108	104·3	28·0	168	162·3	43·5	228	220·2	59·0	288	278·2	74·5
49	47·3	12·7	109	105·3	28·2	169	163·2	43·7	229	221·2	59·3	289	279·2	74·8
50	48·3	12·9	110	106·3	28·5	170	164·2	44·0	230	222·2	59·5	290	280·1	75·1
51	49·3	13·2	111	107·2	28·7	171	165·2	44·3	231	223·1	59·8	291	281·1	75·3
52	50·2	13·5	112	108·2	29·0	172	166·1	44·5	232	224·1	60·0	292	282·1	75·6
53	51·2	13·7	113	109·1	29·2	173	167·1	44·8	233	225·1	60·3	293	283·0	75·8
54	52·2	14·0	114	110·1	29·5	174	168·1	45·0	234	226·0	60·6	294	284·0	76·1
55	53·1	14·2	115	111·1	29·8	175	169·0	45·3	235	227·0	60·8	295	284·9	76·4
56	54·1	14·5	116	112·0	30·0	176	170·0	45·6	236	228·0	61·1	296	285·9	76·6
57	55·1	14·8	117	113·0	30·3	177	171·0	45·8	237	228·9	61·3	297	286·9	76·9
58	56·0	15·0	118	114·0	30·5	178	171·9	46·1	238	229·9	61·6	298	287·8	77·1
59	57·0	15·3	119	114·9	30·8	179	172·9	46·3	239	230·9	61·9	299	288·8	77·4
60	58·0	15·5	120	115·9	31·1	180	173·9	46·6	240	231·8	62·1	300	289·8	77·6
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist.	Dep.	Lat.

75° = 5h. 0m.

TABLE 2.

Traverse Table to 16 Degrees = 1h. 4m.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	1·0	0·3	61	58·6	16·8	121	116·3	33·4	181	174·0	49·9	241	231·7	66·4
2	1·9	0·6	62	59·6	17·1	122	117·3	33·6	182	174·9	50·2	242	232·6	66·7
3	2·9	0·8	63	60·6	17·4	123	118·2	33·9	183	175·9	50·4	243	233·6	67·0
4	3·8	1·1	64	61·5	17·6	124	119·2	34·2	184	176·9	50·7	244	234·5	67·3
5	4·8	1·4	65	62·5	17·9	125	120·2	34·5	185	177·8	51·0	245	235·5	67·5
6	5·8	1·7	66	63·4	18·2	126	121·1	34·7	186	178·8	51·3	246	236·5	67·8
7	6·7	1·9	67	64·4	18·5	127	122·1	35·0	187	179·8	51·5	247	237·4	68·1
8	7·7	2·2	68	65·4	18·7	128	123·0	35·3	188	180·7	51·8	248	238·4	68·4
9	8·7	2·5	69	66·3	19·0	129	124·0	35·6	189	181·7	52·1	249	239·4	68·6
10	9·6	2·8	70	67·3	19·3	130	125·0	35·8	190	182·6	52·4	250	240·3	68·9
11	10·6	3·0	71	68·2	19·6	131	125·9	36·1	191	183·6	52·6	251	241·3	69·2
12	11·5	3·3	72	69·2	19·8	132	126·9	36·4	192	184·6	52·9	252	242·2	69·5
13	12·5	3·6	73	70·2	20·1	133	127·8	36·7	193	185·5	53·2	253	243·2	69·7
14	13·5	3·9	74	71·1	20·4	134	128·8	36·9	194	186·5	53·5	254	244·2	70·0
15	14·4	4·1	75	72·1	20·7	135	129·8	37·2	195	187·4	53·7	255	245·1	70·3
16	15·4	4·4	76	73·1	20·9	136	130·7	37·5	196	188·4	54·0	256	246·1	70·6
17	16·3	4·7	77	74·0	21·2	137	131·7	37·8	197	189·4	54·3	257	247·0	70·8
18	17·3	5·0	78	75·0	21·5	138	132·7	38·0	198	190·3	54·6	258	248·0	71·1
19	18·3	5·2	79	75·9	21·8	139	133·6	38·3	199	191·3	54·9	259	249·0	71·4
20	19·2	5·5	80	76·9	22·1	140	134·6	38·6	200	192·3	55·1	260	249·9	71·7
21	20·2	5·8	81	77·9	22·3	141	135·5	38·9	201	193·2	55·4	261	250·9	71·9
22	21·1	6·1	82	78·8	22·6	142	136·5	39·1	202	194·2	55·7	262	251·9	72·2
23	22·1	6·3	83	79·8	22·9	143	137·5	39·4	203	195·1	56·0	263	252·8	72·5
24	23·1	6·6	84	80·7	23·2	144	138·4	39·7	204	196·1	56·2	264	253·8	72·8
25	24·0	6·9	85	81·7	23·4	145	139·4	40·0	205	197·1	56·5	265	254·7	73·0
26	25·0	7·2	86	82·7	23·7	146	140·3	40·2	206	198·0	56·8	266	255·7	73·3
27	26·0	7·4	87	83·6	24·0	147	141·3	40·5	207	199·0	57·1	267	256·7	73·6
28	26·9	7·7	88	84·6	24·3	148	142·3	40·8	208	199·9	57·3	268	257·6	73·9
29	27·9	8·0	89	85·6	24·5	149	143·2	41·1	209	200·9	57·6	269	258·6	74·1
30	28·8	8·3	90	86·5	24·8	150	144·2	41·3	210	201·9	57·9	270	259·5	74·4
31	29·8	8·5	91	87·5	25·1	151	145·2	41·6	211	202·8	58·2	271	260·5	74·7
32	30·8	8·8	92	88·4	25·4	152	146·1	41·9	212	203·8	58·4	272	261·5	75·0
33	31·7	9·1	93	89·4	25·6	153	147·1	42·2	213	204·7	58·7	273	262·4	75·2
34	32·7	9·4	94	90·4	25·9	154	148·0	42·4	214	205·7	59·0	274	263·4	75·5
35	33·6	9·6	95	91·3	26·2	155	149·0	42·7	215	206·7	59·3	275	264·3	75·8
36	34·6	9·9	96	92·3	26·5	156	150·0	43·0	216	207·6	59·5	276	265·3	76·1
37	35·6	10·2	97	93·2	26·7	157	150. 9	43·3	217	208·6	59·8	277	266·3	76·4
38	36·5	10·5	98	94·2	27·0	158	151·9	43·6	218	209·6	60·1	278	267·2	76·6
39	37·5	10·7	99	95·2	27·3	159	152·8	43·8	219	210·5	60·4	279	268·2	76·9
40	38·5	11·0	100	96·1	27·6	160	153·8	44·1	220	211·5	60·6	280	269·2	77·2
41	39·4	11·3	101	97·1	27·8	161	154·8	44·4	221	212·4	60·9	281	270·1	77·5
42	40·4	11·6	102	98·0	28·1	162	155·7	44·7	222	213·4	61·2	282	271·1	77·7
43	41·3	11·9	103	99·0	28·4	163	156·7	44·9	223	214·4	61·5	283	272·0	78·0
44	42·3	12·1	104	100·0	28·7	164	157·6	45·2	224	215·3	61·7	284	273·0	78·3
45	43·3	12·4	105	100·9	28·9	165	158·6	45·5	225	216·3	62·0	285	274·0	78·6
46	44·2	12·7	106	101·9	29·2	166	159·6	45·8	226	217·2	62·3	286	274·9	78·8
47	45·2	13·0	107	102·9	29·5	167	160·5	46·0	227	218·2	62·6	287	275·9	79·1
48	46·1	13·2	108	103·8	29·8	168	161·5	46·3	228	219·2	62·8	288	276·8	79·4
49	47·1	13·5	109	104·8	30·0	169	162·5	46·6	229	220·1	63·1	289	277·8	79·7
50	48·1	13·8	110	105·7	30·3	170	163·4	46·9	230	221·1	63·4	290	278·8	79·9
51	49·0	14·1	111	106·7	30·6	171	164·4	47·1	231	222·1	63·7	291	279·7	80·2
52	50·0	14·3	112	107·7	30·9	172	165·3	47·4	232	223·0	63·9	292	280·7	80·5
53	50·9	14·6	113	108·6	31·1	173	166·3	47·7	233	224·0	64·2	293	281·6	80·8
54	51·9	14·9	114	109·6	31·4	174	167·3	48·0	234	224·9	64·5	294	282·6	81·0
55	52·9	15·2	115	110·5	31·7	175	168·2	48·2	235	225·9	64·8	295	283·6	81·3
56	53·8	15·4	116	111·5	32·0	176	169·2	48·5	236	226·9	65·1	296	284·5	81·6
57	54·8	15·7	117	112·5	32·2	177	170·1	48·8	237	227·8	65·3	297	285·5	81·9
58	55·8	16·0	118	113·4	32·5	178	171·1	49·1	238	228·8	65·6	298	286·5	82·1
59	56·7	16·3	119	114·4	32·8	179	172·1	49·3	239	229·7	65·9	299	287·4	82·4
60	57·7	16·5	120	115·4	33·1	180	173·0	49·6	240	230·7	66·2	300	288·4	82·7
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

74° = 4h. 56m.

TABLE 2.

Traverse Table to 17 Degrees = 1h. 8m.

Dist	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	1·0	0·3	61	58·3	17·8	121	115·7	35·4	181	173·1	52·9	241	230·5	70·5
2	1·9	0·6	62	59·3	18·1	122	116·7	35·7	182	174·0	53.2	242	231·4	70·8
3	2·9	0·9	63	60·2	18·4	123	117·6	36·0	183	175·0	53·5	243	232·4	71·0
4	3·8	1·2	64	61·2	18·7	124	118·6	36·3	184	176·0	53·8	244	233·3	71·3
5	4·8	1·5	65	62·2	19·0	125	119·5	36·5	185	176·9	54·1	245	234·3	71·6
6	5·7	1·8	66	63·1	19·3	126	120·5	36·8	186	177·9	54·4	246	235·3	71·9
7	6·7	2·0	67	64·1	19·6	127	121·5	37·1	187	178·8	54·7	247	236·2	72·2
8	7·7	2·3	68	65·0	19·9	128	122·4	37·4	188	179·8	55·0	248	237·2	72·5
9	8·6	2·6	69	66·0	20·2	129	123·4	37·7	189	180·7	55·3	249	238·1	72·8
10	9·6	2·9	70	66·9	20·5	130	124·3	38·0	190	181·7	55·6	250	239·1	73·1
11	10·5	3·2	71	67·9	20·8	131	125·3	38·3	191	182·7	55·8	251	240·0	73·4
12	11·5	3·5	72	68·9	21·1	132	126·2	38·6	192	183·6	56·1	252	241·0	73·7
13	12·4	3·8	73	69·8	21·3	133	127·2	38·9	193	184·6	56·4	253	241·9	74·0
14	13·4	4·1	74	70·8	21·6	134	128·1	39·2	194	185·5	56·7	254	242·9	74·3
15	14·3	4·4	75	71·7	21·9	135	129·1	39·5	195	186·5	57·0	255	243·9	74·6
16	15·3	4·7	76	72·7	22·2	136	130·1	39·8	196	187·4	57·3	256	244·8	74·8
17	16·3	5·0	77	73·6	22·5	137	131·0	40·1	197	188·4	57·6	257	245·8	75·1
18	17·2	5·3	78	74·6	22·8	138	132·0	40·3	198	189·3	57·9	258	246·7	75·4
19	18·2	5·6	79	75·5	23·1	139	132·9	40·6	199	190·3	58·2	259	247·7	75·7
20	19·1	5·8	80	76·5	23·3	140	133·9	40·9	200	191·3	58·5	260	248·6	76·0
21	20·1	6·1	81	77·5	23·7	141	134·8	41·2	201	192·2	58·8	261	249·6	76·3
22	21·0	6·4	82	78·4	24·0	142	135·8	41·5	202	193·2	59·1	262	250·6	76·6
23	22·0	6·7	83	79·4	24·3	143	136·8	41·8	203	194·1	59·4	263	251·5	76·9
24	23·0	7·0	84	80·3	24·6	144	137·7	42·1	204	195·1	59·6	264	252·5	77·2
25	23·9	7·3	85	81·3	24·9	145	138·7	42·4	205	196·0	59·9	265	253·4	77·5
26	24·9	7·6	86	82·2	25.1	146	139·6	42·7	206	197·0	60·2	266	254·4	77·8
27	25·8	7·9	87	83·2	25·4	147	140·6	43·0	207	198·0	60·5	267	255·3	78·1
28	26·8	8·2	88	84·2	25·7	148	141·5	43·3	208	198·9	60·8	268	256·3	78·4
29	27·7	8·5	89	85·1	26·0	149	142·5	43·6	209	199·9	61·1	269	257·2	78·6
30	28·7	8·8	90	86·1	26·3	150	143·4	43·9	210	200·8	61·4	270	258·2	78·9
31	29·6	9·1	91	87·0	26·6	151	144·4	44·1	211	201·8	61·7	271	259·2	79·2
32	30·6	9·4	92	88·0	26·9	152	145·4	44·4	212	202·7	62·0	272	260·1	79·5
33	31·6	9·6	93	88·9	27·2	153	146·3	44·7	213	203·7	62·3	273	261·1	79·8
34	32·5	9·9	94	89·9	27·5	154	147·3	45·0	214	204·6	62·6	274	262·0	80·1
35	33·5	10·2	95	90·8	27·8	155	148·2	45·3	215	205·6	62·9	275	263.0	80·4
36	34·4	10·5	96	91·8	28·1	156	149·2	45·6	216	206·6	63·2	276	263·9	80·7
37	35·4	10·8	97	92·8	28·4	157	150·1	45·9	217	207·5	63·4	277	264·9	81·0
38	36·3	11·1	98	93·7	28·7	158	151·1	46·2	218	208·5	63·7	278	265·9	81·3
39	37·3	11·4	99	94·7	28·9	159	152·1	46·5	219	209·4	64·0	279	266·8	81·6
40	38·3	11·7	100	95·6	29·2	160	153·0	46·8	220	210·4	64·3	280	267·8	81·9
41	39·2	12·0	101	96·6	29·5	161	154·0	47·1	221	211·3	64·6	281	268·7	82·2
42	40·2	12·3	102	97·5	29·8	162	154·9	47·4	222	212·3	64·9	282	269·7	82·4
43	41·1	12·6	103	98·5	30·1	163	155·9	47·7	223	213·3	65·2	283	270·6	82·7
44	42·1	12·9	104	99·5	30·4	164	156·8	47·9	224	214·2	65·5	284	271·6	83·0
45	43·0	13·2	105	100·4	30·7	165	157·8	48·2	225	215·2	65·8	285	272·5	83·3
46	44·0	13·4	106	101·4	31·0	166	158·7	48·5	226	216·1	66·1	286	273·5	83·6
47	44·9	13·7	107	102·3	31·3	167	159·7	48·8	227	217·1	66·4	287	274·5	83·9
48	45·9	14·0	108	103·3	31·6	168	160·7	49·1	228	218·0	66·7	288	275·4	84·2
49	46·9	14·3	109	104·2	31·9	169	161·6	49·4	229	219·0	67·0	289	276·4	84·5
50	47·8	14·6	110	105·2	32·2	170	162·6	49·7	230	220·0	67·2	290	277·3	84·8
51	48·8	14·9	111	106·1	32·5	171	163·5	50·0	231	220·9	67·5	291	278·3	85·1
52	49·7	15·2	112	107·1	32·7	172	164·5	50·3	232	221·9	67·8	292	279·2	85·4
53	50·7	15·5	113	108·1	33·0	173	165·4	50·6	233	222·8	68·1	293	280·2	85·7
54	51·6	15·8	114	109·0	33·3	174	166·4	50·9	234	223·8	68·4	294	281·2	86·0
55	52·6	16·1	115	110·0	33·6	175	167·4	51·2	235	224·7	68·7	295	282·1	86·2
56	53·6	16·4	116	110·9	33·9	176	168·3	51·5	236	225·7	69·0	296	283·1	86·5
57	54.5	16·7	117	111·9	34·2	177	169·3	51·7	237	226·6	69·3	297	284·0	86·8
58	55·5	17·0	118	112·8	34·5	178	170·2	52·0	238	227·6	69·6	298	285·0	87·1
59	56·4	17·2	119	113·8	34·8	179	171.2	52·3	239	228·6	69·9	299	285·9	87·4
60	57·4	17·5	120	114·8	35·1	180	172·1	52·6	240	229·5	70·2	300	286·9	87·7
Dist	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

TABLE 2.

Traverse Table to 18 Degrees = 1h. 12m.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	1·0	0·3	61	58·0	18·9	121	115·1	37·4	181	172·1	55·9	241	229·2	74·5
2	1·9	0·6	62	59·0	19·2	122	116·0	37·7	182	173·1	56·2	242	230·2	74·8
3	2·9	0·9	63	59·9	19·5	123	117·0	38·0	183	174·0	56·6	243	231·1	75·1
4	3·8	1·2	64	60·9	19·8	124	117·9	38·3	184	175·0	56·9	244	232·1	75·4
5	4·8	1·5	65	61·8	20·1	125	118·9	38·6	185	175·9	57·2	245	233·0	75·7
6	5·7	1·9	66	62·8	20·4	126	119·8	38·9	186	176·9	57·5	246	234·0	76·0
7	6·7	2·2	67	63·7	20·7	127	120·8	39·2	187	177·8	57·8	247	234·9	76·3
8	7·6	2·5	68	64·7	21·0	128	121·7	39·6	188	178·8	58·1	248	235·9	76·6
9	8·6	2·8	69	65·6	21·3	129	122·7	39·9	189	179·7	58·4	249	236·8	76·9
10	9·5	3·1	70	66·6	21·6	130	123·6	40·2	190	180·7	58·7	250	237·8	77·3
11	10·5	3·4	71	67.5	21·9	131	124·6	40·5	191	181·7	59·0	251	238·7	77·6
12	11·4	3·7	72	68·5	22·2	132	125·5	40·8	192	182·6	59·3	252	239·7	77·9
13	12·4	4·0	73	69·4	22·6	133	126·5	41·1	193	183·6	59·6	253	240·6	78·2
14	13·3	4·3	74	70·4	22·9	134	127·4	41·4	194	184·5	59·9	254	241·6	78·5
15	14·3	4·6	75	71·3	23·2	135	128·4	41·7	195	185·5	60·3	255	242·5	78·8
16	15·2	4·9	76	72·3	23·5	136	129·3	42·0	196	186·4	60·6	256	243·5	79·1
17	16·2	5·3	77	73·2	23·8	137	130·3	42·3	197	187·4	60·9	257	244·4	79·4
18	17·1	5·6	78	74·2	24·1	138	131·2	42·6	198	188·3	61·2	258	245·4	79·7
19	18·1	5·9	79	75·1	24·4	139	132·2	43·0	199	189·3	61·5	259	246·3	80·0
20	19·0	6·2	80	76·1	24·7	140	133·1	43·3	200	190·2	61·8	260	247·3	80·3
21	20·0	6·5	81	77·0	25·0	141	134·1	43·6	201	191·2	62·1	261	248·2	80·7
22	20·9	6·8	82	78·0	25·3	142	135·1	43·9	202	192·1	62·4	262	249·2	81·0
23	21·9	7·1	83	78·9	25·6	143	136·0	44·2	203	193·1	62·7	263	250·1	81·3
24	22·8	7·4	84	79·9	26·0	144	137·0	44·5	204	194·0	63·0	264	251·1	81·6
25	23·8	7·7	85	80·8	26·3	145	137·9	44·8	205	195·0	63·3	265	252·0	81·9
26	24·7	8·0	86	81·8	26·6	146	138·9	45·1	206	195·9	63·7	266	253·0	82·2
27	25·7	8·3	87	82·7	26·9	147	139·8	45·4	207	196·9	64·0	267	253·9	82·5
28	26·6	8·7	88	83·7	27·2	148	140·8	45·7	208	197·8	64·3	268	254·9	82·8
29	27·6	9·0	89	84·6	27·5	149	141·7	46·0	209	198·8	64·6	269	255·8	83·1
30	28·5	9·3	90	85·6	27·8	150	142·7	46·4	210	199·7	64·9	270	256·8	83·4
31	29·5	9·6	91	86·5	28·1	151	143·6	46·7	211	200·7	65·2	271	257·7	83·7
32	30·4	9·9	92	87·5	28·4	152	144·6	47·0	212	201·6	65·5	272	258·7	84·1
33	31·4	10·2	93	88·4	28·7	153	145·5	47·3	213	202·6	65·8	273	259·6	84·4
34	32·3	10·5	94	89·4	29·0	154	146·5	47·6	214	203·5	66·1	274	260·6	84·7
35	33·3	10·8	95	90·4	29·4	155	147·4	47·9	215	204·5	66·4	275	261·5	85·0
36	34·2	11·1	96	91·3	29·7	156	148·4	48.2	216	205·4	66·7	276	262·5	85·3
37	35·2	11·4	97	92·3	30·0	157	149·3	48·5	217	206·4	67·1	277	263·4	85·6
38	36·1	11·7	98	93·2	30·3	158	150·3	48·8	218	207·3	67·4	278	264·4	85·9
39	37·1	12·1	99	94·2	30·6	159	151·2	49·1	219	208·3	67·7	279	265·3	86·2
40	38·0	12·4	100	95·1	30·9	160	152·2	49·4	220	209·2	68·0	280	266·3	86·5
41	39·0	12·7	101	96·1	31·2	161	153·1	49·8	221	210·2	68·3	281	267·2	86·8
42	39·9	13·0	102	97·0	31·5	162	154·1	50·1	222	211·1	68·6	282	268·2	87·1
43	40·9	13·3	103	98·0	31·8	163	155·0	50·4	223	212·1	68·9	283	269·1	87·5
44	41·8	13·6	104	98·9	32·1	164	156·0	50·7	224	213·0	69·2	284	270·1	87·8
45	42·8	13·9	105	99·9	32·4	165	156·9	51·0	225	214·0	69·5	285	271·1	88·1
46	43·7	14·2	106	100·8	32·8	166	157·9	51·3	226	214·9	69·8	286	272·0	88·4
47	44·7	14·5	107	101·8	33·1	167	158·8	51·6	227	215·9	70·1	287	273·0	88·7
48	45·7	14·8	108	102·7	33·4	168	159·8	51·9	228	216·8	70·5	288	273·9	89·0
49	46·6	15·1	109	103·7	33·7	169	160·7	52·2	229	217·8	70·8	289	274·9	89·3
50	47·6	15·5	110	104·6	34·0	170	161·7	52·5	230	218·7	71·1	290	275·8	89·6
51	48·5	15·8	111	105·6	34·3	171	162·6	52·8	231	219·7	71·4	291	276·8	89·9
52	49·5	16·1	112	106·5	34·6	172	163·6	53·2	232	220·6	71·7	292	277·7	90·2
53	50·4	16·4	113	107·5	34·9	173	164·5	53·5	233	221·6	72·0	293	278·7	90·5
54	51·4	16·7	114	108·4	35·2	174	165·5	53·8	234	222·5	72·3	294	279·6	90·9
55	52·3	17·0	115	109·4	35·5	175	166·4	54·1	235	223·5	72·6	295	280·6	91·2
56	53·3	17·3	116	110·3	35·8	176	167·4	54·4	236	224·4	72·9	296	281·5	91·5
57	54·2	17·6	117	111·3	36·2	177	168·3	54·7	237	225·4	73·2	297	282·5	91·8
58	55·2	17·9	118	112·2	36·5	178	169·3	55·0	238	226·4	73·5	298	283·4	92·1
59	56·1	18·2	119	113·2	36·8	179	170·2	55·3	239	227·3	73·9	299	284·4	92·4
60	57·1	18·5	120	114·1	37·1	180	171·2	55·6	240	228·3	74·2	300	285·3	92·7
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

72° = 4h. 48m.

TABLE 2.

Traverse Table to 19 Degrees=1h. 16m.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	0·9	0·3	61	57·7	19·9	121	114·4	39·4	181	171·1	58·9	241	227·9	78·5
2	1·9	0·7	62	58·6	20·2	122	115·4	39·7	182	172·1	59·3	242	228·8	78·8
3	2·8	1·0	63	59·6	20·5	123	116·3	40·0	183	173·0	59·8	243	229·8	79·1
4	3·8	1·3	64	60·5	20·8	124	117·2	40·4	184	174·0	59·9	244	230·7	79·4
5	4·7	1·6	65	61·5	21·2	125	118·2	40·7	185	174·9	60·2	245	231·7	79·8
6	5·7	2·0	66	62·4	21·5	126	119·1	41·0	186	175·9	60·6	246	232·6	80·1
7	6·6	2·3	67	63·3	21·8	127	120·1	41·3	187	176·8	60·9	247	233·5	80·4
8	7·6	2·6	68	64·3	22·1	128	121·0	41·7	188	177·8	61·2	248	234·5	80·7
9	8·5	2·9	69	65·2	22·5	129	122·0	42·0	189	178·7	61·5	249	235·4	81·1
10	9·5	3·3	70	66·2	22·8	130	122·9	42·3	190	179·6	61·9	250	236·4	81·4
11	10·4	3·6	71	67·1	23·1	131	123·9	42·6	191	180·6	62·2	251	237·3	81·7
12	11·3	3·9	72	68·1	23·4	132	124·8	43·0	192	181·5	62·5	252	238.3	82·0
13	12·3	4·2	73	69·0	23·8	133	125·8	43·3	193	182·5	62·8	253	239.2	82·4
14	13·2	4·6	74	70·0	24·1	134	126·7	43·6	194	183·4	63·2	254	240·2	82·7
15	14·2	4·9	75	70·9	24·4	135	127·6	44·0	195	184·4	63·5	255	241·1	83·0
16	15·1	5·2	76	71·9	24·7	136	128·6	44·3	196	185·3	63·8	256	242·1	83·3
17	16·1	5·5	77	72·8	25·1	137	129·5	44·6	197	186·3	64·1	257	243·0	83·7
18	17·0	5·9	78	73·8	25·4	138	130·5	44·9	198	187·2	64·5	258	243·9	84·0
19	18·0	6·2	79	74·7	25·7	139	131·4	45·3	199	188·2	64·8	259	244·9	84·3
20	18·9	6·5	80	75·6	26·0	140	132·4	45·6	200	189·1	65·1	260	245·8	84·6
21	19·9	6·8	81	76·6	26·4	141	133·3	45·9	201	190·0	65·4	261	246·8	85·0
22	20·8	7·2	82	77·5	26·7	142	134·3	46·2	202	191·0	65·8	262	247·7	85·3
23	21.7	7·5	83	78·5	27·0	143	135·2	46·6	203	191·9	66·1	263	248·7	85·6
24	22·7	7·8	84	79·4	27·3	144	136·2	46·9	204	192·9	66·4	264	249·6	86·0
25	23·6	8·1	85	80·4	27·7	145	137·1	47·2	205	193·8	66·7	265	250·6	86·3
26	24·6	8·5	86	81·3	28·0	146	138·0	47·5	206	194·8	67·1	266	251·5	86·6
27	25·5	8·8	87	82·3	28·3	147	139·0	47·9	207	195·7	67·4	267	252·5	86·9
28	26·5	9·1	88	83·2	28·7	148	139·9	48·2	208	196·7	67·7	268	253·4	87·3
29	27·4	9·4	89	84·2	29·0	149	140·9	48·5	209	197·6	68·0	269	254·3	87·6
30	28·4	9·8	90	85·1	29·3	150	141·8	48·8	210	198·6	68·4	270	255·3	87·9
31	29·3	10·1	91	86·0	29·6	151	142·8	49·2	211	199·5	68·7	271	256·2	88·2
32	30·3	10·4	92	87·0	30·0	152	143·7	49·5	212	200·4	69·0	272	257·2	88·6
33	31·2	10·7	93	87·9	30·3	153	144·7	49·8	213	201·4	69·3	273	258·1	88·9
34	32·1	11·1	94	88·9	30.6	154	145·6	50·1	214	202·3	69·7	274	259·1	89·2
35	33·1	11·4	95	89·8	30·9	155	146·6	50·5	215	203·3	70·0	275	260·0	89·5
36	34·0	11·7	96	90·8	31·3	156	147·5	50·8	216	204·2	70·3	276	261·0	89·9
37	35·0	12·0	97	91·7	31·6	157	148·4	51·1	217	205·2	70·6	277	261·9	90·2
38	35·9	12·4	98	92·7	31·9	158	149·4	51·4	218	206·1	71·0	278	262·9	90·5
39	36·9	12·7	99	93·6	32·2	159	150·3	51·8	219	207·1	71·3	279	263·8	90·8
40	37·8	13·0	100	94·6	32·6	160	151·3	52·1	220	208·0	71·6	280	264·7	91·2
41	38·8	13·3	101	95·5	32·9	161	152·2	52·4	221	209·0	72·0	281	265·7	91·5
42	39·7	13·7	102	96·4	33·2	162	153·2	52·7	222	209·9	72·3	282	266·6	91·8
43	40·7	14·0	103	97·4	33·5	163	154·1	53·1	223	210·9	72·6	283	267·6	92·1
44	41·6	14·3	104	98·3	33·9	164	155·1	53·4	224	211·8	72·9	284	268·5	92·5
45	42·5	14·7	105	99·3	34·2	165	156·0	53·7	225	212·7	73·3	285	269·5	92·8
46	43·5	15·0	106	100·2	34·5	166	157·0	54·0	226	213·7	73·6	286	270·4	93·1
47	44·4	15·3	107	101·2	34·8	167	157·9	54·4	227	214·6	73·9	287	271·4	93·4
48	45·4	15·6	108	102·1	35·2	168	158·8	54·7	228	215·6	74·2	288	272·3	93·8
49	46·3	16·0	109	103·1	35·5	169	159·8	55·0	229	216·5	74·6	289	273·3	94·1
50	47·3	16·3	110	104·0	35·8	170	160·7	55·3	230	217·5	74·9	290	274·2	94·4
51	48·2	16·6	111	105·0	36·1	171	161·7	55·7	231	218·4	75·2	291	275·1	94·7
52	49·2	16·9	112	105·9	36·5	172	162·6	56·0	232	219·4	75·5	292	276·1	95·1
53	50·1	17·3	113	106·8	36·8	173	163·6	56.3	233	220·3	75·9	293	277·0	95·4
54	51·1	17·6	114	107·8	37·1	174	164·5	56·6	234	221·3	76·2	294	278·0	95·7
55	52·0	17·9	115	108·7	37·4	175	165·5	57·0	235	222·2	76·5	295	278·9	96·0
56	52·9	18·2	116	109·7	37·8	176	166·4	57·3	236	223·1	76·8	296	279·9	96·4
57	53·9	18·6	117	110·6	38·1	177	167·4	57·6	237	224·1	77·2	297	280·8	96·7
58	54·8	18·9	118	111·6	38·4	178	168·3	58·0	238	225·0	77·5	298	281·8	97·0
59	55·8	19·2	119	112·5	38·7	179	169·2	58·3	239	226·0	77·8	299	282·7	97·3
60	56·7	19·5	120	113·5	39·1	180	170·2	58·6	240	226·9	78·1	300	283·7	97·7
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

71°=4h. 44m.

TABLE 2.

Traverse Table to 20 Degrees=1h 20m.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	0·9	0·3	61	57·3	20·9	121	113·7	41·4	181	170·1	61·9	241	226·5	82·4
2	1·9	0·7	62	58·3	21·2	122	114·6	41·7	182	171·0	62·2	242	227·4	82·8
3	2·8	1·0	63	59·2	21·5	123	115·6	42·1	183	172·0	62·6	243	228·3	83·1
4	3·8	1·4	64	60·1	21·9	124	116·5	42·4	184	172·9	62.9	244	229·3	83·5
5	4·7	1·7	65	61·1	22·2	125	117·5	42·8	185	173·8	63·3	245	230·2	83·8
6	5·6	2·1	66	62·0	22·6	126	118·4	43·1	186	174·8	63·6	246	231·2	84·2
7	6·6	2·4	67	63·0	22·9	127	119·3	43·4	187	175·7	64·0	247	232·1	84·5
8	7·5	2·7	68	63·9	23·3	128	120·3	43·8	188	176·7	64·3	248	233·0	84·8
9	8·5	3·1	69	64·8	23·6	129	121·2	44·1	189	177·6	64·6	249	234·0	85·2
10	9·4	3·4	70	65·8	23·9	130	122·2	44·5	190	178·5	65·0	250	234·9	85·5
11	10·3	3·8	71	66·7	24·3	131	123·1	44·8	191	179·5	65·3	251	235·9	85·8
12	11·3	4·1	72	67·7	24·6	132	124·0	45·1	192	180·4	66·7	252	236·8	86·2
13	12·2	4·4	73	68·6	25·0	133	125·0	45·5	193	181·4	66·0	253	237·7	86·5
14	13·2	4·8	74	69·5	25·3	134	125·9	45·8	194	182·3	66·4	254	238·7	86·9
15	14·1	5·1	75	70·5	25·7	135	126·9	46·2	195	183·2	66·7	255	239·6	87·2
16	15·0	5·5	76	71·4	26·0	136	127·8	46·5	196	184·2	67·0	256	240·6	87·6
17	16·0	5·8	77	72·4	26·3	137	128·7	46·9	197	185·1	67·4	257	241·5	87·9
18	16·9	6·2	78	73·3	26·7	138	129·7	47·2	198	186·1	67·7	258	242·4	88·2
19	17·9	6·6	79	74·2	27·0	139	130·6	47·5	199	187·0	68·1	259	243·4	88·6
20	18·8	6·8	80	75·2	27·4	140	131·6	47·9	200	187·9	68·4	260	244·3	88·9
21	19·7	7·2	81	76·1	27·7	141	132·5	48·2	201	188·9	68·7	261	245·3	89·3
22	20·7	7·5	82	77·1	28·0	142	133·4	48·6	202	189·8	69·1	262	246·2	89·6
23	21·6	7·9	83	78·0	28·4	143	134·4	48·9	203	190·8	69·4	263	247·1	90·0
24	22·6	8·2	84	78·9	28·7	144	135·3	49·3	204	191·7	69·8	264	248·1	90·3
25	23·5	8·6	85	79·9	29·1	145	136·3	49·6	205	192·6	70·1	265	249·0	90·6
26	24·4	8.9	86	80·8	29·4	146	137·2	49·9	206	193·6	70·5	266	250·0	91·0
27	25·4	9·2	87	81·8	29·8	147	138·1	50·3	207	194·5	70·8	267	250·9	91·3
28	26·3	9·6	88	82·7	30·1	148	139·1	50·6	208	195·5	71·1	268	251·8	91·7
29	27·3	9·9	89	83·6	30·4	149	140·0	51·0	209	196·4	71·5	269	252·8	92·0
30	28·2	10·3	90	84·6	30·8	150	141·0	51·3	210	197·3	71·8	270	253·7	92·3
31	29·1	10·6	91	85·5	31·1	151	141·9	51·6	211	198·3	72·2	271	254·7	92·7
32	30·1	10·9	92	86·5	31·5	152	142·8	52·0	212	199·2	72·5	272	255·6	93·0
33	31·0	11·3	93	87·4	31·8	153	143·8	52·3	213	200·2	72·9	273	256·5	93·4
34	31·9	11·6	94	88·3	32·1	154	144·7	52·7	214	201·1	73·2	274	257·5	93·7
35	32·9	12·0	95	89·3	32·5	155	145·7	53·0	215	202·0	73·5	275	258·4	94·1
36	33·8	12·3	96	90·2	32·8	156	146·6	53·4	216	203·0	73·9	276	259·4	94·4
37	34·8	12·7	97	91·2	33·2	157	147·5	53·7	217	203·9	74·2	277	260·3	94·7
38	35·7	13·0	98	92·1	33·5	158	148·5	54·0	218	204·9	74·6	278	261·2	95·1
39	36·6	13·3	99	93·0	33·9	159	149·4	54·4	219	205·8	74·9	279	262·2	95·4
40	37·6	13·7	100	94·0	34·2	160	150·4	54·7	220	206·7	75·2	280	263·1	95·8
41	38·5	14·0	101	94·9	34·5	161	151·3	55·1	221	207·7	75·6	281	264·1	96·1
42	39·5	14·4	102	95·8	34·9	162	152·2	55·4	222	208·6	75·9	282	265·0	96·4
43	40·4	14·7	103	96·8	35·2	163	153·2	55·7	223	209·6	76·3	283	265·9	96·8
44	41·3	15·0	104	97·7	35·6	164	154·1	56·1	224	210·5	76·6	284	266·9	97·1
45	42·3	15·4	105	98·7	35·9	165	155·0	56·4	225	211·4	77·0	285	267·8	97·5
46	43·2	15·7	106	99·6	36·3	166	156·0	56·8	226	212·4	77·3	286	268·8	97·8
47	44·2	16·1	107	100·5	36·6	167	156·9	57·1	227	213·3	77·6	287	269·7	98·2
48	45·1	16·4	108	101·5	36·9	168	157·9	57·5	228	214·2	78·0	288	270·6	98·5
49	46·0	16·8	109	102·4	37·3	169	158·8	57·8	229	215·2	78·3	289	271·6	98·8
50	47·0	17·1	110	103·4	37·6	170	159·7	58·1	230	216·1	78·7	290	272·5	99·2
51	47·9	17·4	111	104·3	38·0	171	160·7	58·5	231	217·1	79·0	291	273·5	99·5
52	48·9	17·8	112	105·2	38·3	172	161·6	58·8	232	218·0	79·3	292	274·4	99·9
53	49·8	18·1	113	106·2	38·6	173	162·6	59·2	233	218·9	79·7	293	275·3	100·2
54	50·7	18·5	114	107·1	39·0	174	163·5	59·5	234	219·9	80·0	294	276·3	100·6
55	51·7	18·8	115	108·1	39·3	175	164·4	59·9	235	220·8	80·4	295	277·2	100·9
56	52·6	19·2	116	109·0	39·7	176	165·4	60·2	236	221·8	80·7	296	278·1	101·2
57	53·6	19·5	117	109·9	40·0	177	166·3	60·5	237	222·7	81·1	297	279·1	101·6
58	54·5	19·8	118	110·9	40·4	178	167·3	60·9	238	223·6	81·4	298	280·0	101·9
59	55·4	20·2	119	111·8	40·7	179	168·2	61·2	239	224·6	81·7	299	281·0	102·3
60	56·4	20·5	120	112·8	41·0	180	169·1	61·6	240	225·5	82·1	300	281·9	102·6
Dist.	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

Traverse Table to 21 Degrees=1h. 24m.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	0·9	0·4	61	56·9	21·9	121	113·0	43·4	181	169·0	64·9	241	225·0	86·4
2	1·9	0·7	62	57·9	22·2	122	113·9	43·7	182	169·9	65·2	242	225·9	86·7
3	2·8	1·1	63	58·8	22·6	123	114·8	44·1	183	170·8	65·6	243	226·9	87·1
4	3·7	1·4	64	59·7	22·9	124	115·8	44·4	184	171·8	65·9	244	227·8	87·4
5	4·7	1·8	65	60·7	23·3	125	116·7	44·8	185	172·7	66·3	245	228·7	87·8
6	5·6	2·2	66	61·6	23·7	126	117·6	45·2	186	173·6	66·7	246	229·7	88·2
7	6·5	2·5	67	62·5	24·0	127	118·6	45·5	187	174·6	67·0	247	230·6	88·5
8	7·5	2·9	68	63·5	24·4	128	119·5	45·9	188	175·5	67·4	248	231·5	88·9
9	8·4	3·2	69	64·4	24·7	129	120·4	46·2	189	176·4	67·7	249	232·5	89·2
10	9·3	3·6	70	65·4	25·1	130	121·4	46·6	190	177·4	68·1	250	233·4	89·6
11	10·3	3·9	71	66·3	25·4	131	122·3	46·9	191	178·3	68·4	251	234·3	90·0
12	11·2	4·3	72	67·2	25·8	132	123·2	47·3	192	179·2	68·6	252	235·3	90·3
13	12·1	4·7	73	68·2	26·2	133	124·2	47·7	193	180·2	69·2	253	236·2	90·7
14	13·1	5·0	74	69·1	26·5	134	125·1	48·0	194	181·1	69·5	254	237·1	91·0
15	14·0	5·4	75	70·0	26·9	135	126·0	48·4	195	182·0	69·9	255	238·1	91·4
16	14·9	5·7	76	71·0	27·2	136	127·0	48·7	196	183·0	70·2	256	239·0	91·7
17	15·9	6·1	77	71·9	27·6	137	127·9	49·1	197	183·9	70·6	257	239·9	92·1
18	16·8	6·5	78	72·8	28·0	138	128·8	49·5	198	184·8	71·0	258	240·9	92·5
19	17·7	6·8	79	73·8	28·3	139	129·8	49·8	199	185·8	71·3	259	241·8	92·8
20	18·7	7·2	80	74·7	28·7	140	130·7	50·2	200	186·7	71·7	260	242·7	93·2
21	19·6	7·5	81	75·6	29·0	141	131·6	50·5	201	187·6	72·0	261	243·7	93·5
22	20·5	7·9	82	76·6	29·4	142	132·6	50·9	202	188·6	72·4	262	244·6	93·9
23	21·5	8·2	83	77·5	29·7	143	133·5	51·2	203	189·5	72·7	263	245·5	94·3
24	22·4	8 6	84	78·4	30·1	144	134·4	51·6	204	190·4	73·1	264	246·5	94·6
25	23·3	9·0	85	79·4	30·5	145	135·4	52·0	205	191·4	73·5	265	247·4	95·0
26	24·3	9·3	86	80·3	30·8	146	136·3	52·3	206	192·3	73·8	266	248·3	95·3
27	25·2	9·7	87	81·2	31·2	147	137·2	52·7	207	193·3	74·2	267	249·3	95·7
28	26·1	10·0	88	82·2	31·5	148	138·2	53·0	208	194·2	74·5	268	250·2	96·0
29	27·1	10·4	89	83·1	31·9	149	139·1	53·4	209	195·1	74·9	269	251·1	96·4
30	28·0	10·8	90	84·0	32·3	150	140·0	53·8	210	196·1	75·3	270	252·1	96·8
31	28·9	11·1	91	85·0	32·6	151	141·0	54·1	211	197·0	75·6	271	253·0	97·1
32	29·9	11·5	92	85·9	33·0	152	141·9	54·5	212	197·9	76·0	272	253·9	97·5
33	30·8	11·8	93	86·8	33·3	153	142·8	54·8	213	198·9	76·3	273	254·9	97·8
34	31·7	12·2	94	87·8	33·7	154	143·8	55·2	214	199·8	76·7	274	255·8	98·2
35	32·7	12.5	95	88·7	34·0	155	144·7	55·5	215	200·7	77·0	275	256·7	98·6
36	33·6	12·9	96	89·6	34·4	156	145·6	55·9	216	201·7	77·4	276	257·7	98·9
37	34·5	13·3	97	90·6	34·8	157	146·6	56·3	217	202·6	77·8	277	258·6	99·3
38	35·5	13·6	98	91·5	35·1	158	147·5	56·6	218	203·5	78·1	278	259·5	99·6
39	36·4	14·0	99	92·4	35·5	159	148·4	57·0	219	204·5	78·5	279	260·5	100·0
40	37·3	14·3	100	93·4	35·8	160	149·4	57·3	220	205·4	78·8	280	261·4	100·3
41	38·3	14·7	101	94·3	36·2	161	150·3	57·7	221	206·3	79·2	281	262·3	100·7
42	39·2	15·1	102	95·2	36·6	162	151·2	58·1	222	207·3	79·6	282	263·3	101·1
43	40·1	15·4	103	96·2	36·9	163	152·2	58·4	223	208·2	79·9	283	264·2	101·4
44	41·1	15·8	104	97·1	37·3	164	153·1	58·8	224	209·1	80·3	284	265·1	101·8
45	42·0	16·1	105	98·0	37·6	165	154·0	59·1	225	210·1	80·6	285	266·1	102 1
46	42·9	16·5	106	99·0	38·0	166	155·0	59·5	226	211·0	81·0	286	267·0	102·5
47	43·9	16·8	107	99·9	38·3	167	155·9	59·8	227	211·9	81·3	287	267·9	102·9
48	44·8	17·2	108	100·8	38·7	168	156·8	60·2	228	212·9	81·7	288	268·9	103·2
49	45·7	17·6	109	101·8	39·1	169	157·8	60·6	229	213·8	82·1	289	269·8	103·6
50	46·7	17·9	110	102·7	39·4	170	158·7	60·9	230	214·7	82·4	290	270·7	103·9
51	47·6	18·3	111	103·6	39·8	171	159·6	61·3	231	215·7	82·8	291	271·7	104·3
52	48·5	18·6	112	104·6	40·1	172	160·6	61·6	232	216·6	83·1	292	272·6	104·6
53	49·5	19·0	113	105·5	40·5	173	161·5	62·0	233	217·5	83·5	293	273·5	105·0
54	50·4	19·4	114	106·4	40·9	174	162·4	62·4	234	218·5	83·9	294	274·5	105·4
55	51·3	19·7	115	107·4	41·2	175	163·4	62·7	235	219·4	84·2	295	275·4	105·7
56	52·3	20·1	116	108·3	41·6	176	164·3	63·1	236	220·3	84·6	296	276·3	106·1
57	53·2	20·4	117	109·2	41·9	177	165·2	63·4	237	221·3	84·9	297	277·3	106·4
58	54·1	20·8	118	110·2	42·3	178	166·2	63·8	238	222·2	85·3	298	278·2	106·8
59	55·1	21·1	119	111·1	42·6	179	167·1	64·1	239	223·1	85·6	299	279·1	107·2
60	56·0	21·5	120	112·0	43·0	180	168·0	64·5	240	224·1	86·0	300	280·1	107·5
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

69°=4h. 36m.

TABLE 2.

Traverse Table to 22 Degrees=1h. 28m.

Dist	Lat.	Dep	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	0·9	0·4	61	56·6	22·9	121	112 2	45·3	181	167·8	67·8	241	223·5	90·
2	1·9	0·7	62	57·5	23·2	122	113·1	45·7	182	168·7	68·2	242	224·4	90·
3	2·8	1·1	63	58·4	23·6	123	114·0	46·1	183	169·7	68·6	243	225·3	91
4	3·7	1·5	64	59·3	24·0	124	115·0	46·5	184	170·6	68·9	244	226·2	91·
5	4·6	1·9	65	60·3	24·3	125	115·9	46·8	185	171·5	69·3	245	227·2	91·
6	5·6	2·2	66	61·2	24·7	126	116·8	47·2	186	172·5	69·7	246	228·1	92·
7	6·5	2·6	67	62·1	25·1	127	117·8	47·6	187	173·4	70·1	247	229·0	92·
8	7·4	3·0	68	63·0	25·5	128	118·7	47·9	188	174·3	70·4	248	229·9	92·
9	8·3	3 4	69	64·0	25·8	129	119·6	48·3	189	175·2	70·8	249	230·9	93·
10	9·3	3·7	70	64·9	26·2	130	120·5	48·7	190	176·2	71·2	250	231·8	93·
11	10·2	4·1	71	65·8	26·6	131	121·5	49·1	191	177·1	71·5	251	232·7	94·
12	11·1	4·5	72	66·8	27·0	132	122·4	49·4	192	178·0	71·9	252	233·7	94·
13	12·1	4·9	73	67·7	27·3	133	123·3	49·8	193	178.9	72·3	253	234·6	94·
14	13·0	5·2	74	68·6	27·7	134	124·2	50·2	194	179·9	72·7	254	235·5	95·
15	13·9	5·6	75	69·5	28·1	135	125·2	50·6	195	180·8	73·0	255	236·4	95·5
16	14·8	6·0	76	70·5	28·5	136	126·1	50·9	196	181·7	73·4	256	237·4	95·9
17	15·8	6·4	77	71·4	28·8	137	127·0	51·3	197	182·7	73·8	257	238·3	96·3
18	16·7	6·7	78	72·3	29·2	138	128·0	51·7	198	183·6	74·2	258	239·2	96·6
19	17·6	7·1	79	73·2	29·6	139	128·9	52·1	199	184·5	74·5	259	240·1	97·0
20	18·5	7·5	80	74·2	30·0	140	129·8	52·4	200	185·4	74·9	260	241·1	97·4
21	19·5	7·9	81	75·1	30·3	141	130·7	52·8	201	186·4	75·3	261	242·0	97·8
22	20·4	8·2	82	76·0	30·7	142	131·7	53·2	202	187·3	75·7	262	242·9	98·1
23	21·3	8·6	83	77·0	31·1	143	132·6	53·6	203	188·2	76·0	263	243·8	98·5
24	22·3	9·0	84	77·9	31·5	144	133·5	53·9	204	189·1	76·4	264	244·8	98·9
25	23·2	9·4	85	78·8	31·8	145	134·4	54·3	205	190·1	76·8	265	245·7	99·3
26	24·1	9·7	86	79·7	32·2	146	135·4	54·7	206	191·0	77·2	266	246·6	99·6
27	25·0	10·1	87	80·7	32·6	147	136·3	55·1	207	191·9	77·5	267	247·6	100·0
28	26·0	10·5	88	81·6	33·0	148	137·2	55·4	208	192·9	77·9	268	248·5	100·4
29	26·9	10·9	89	82·5	33·3	149	138·2	55·8	209	193·8	78·3	269	249·4	100·8
30	27·8	11·2	90	83·4	33·7	150	139·1	56·2	210	194·7	78·7	270	250·3	101·1
31	28·7	11·6	91	84·4	34·1	151	140·0	56·6	211	195·6	79·0	271	251·3	101·5
32	29·7	12·0	92	85·3	34·5	152	140·9	56·9	212	196·6	79·4	272	252·2	101·9
33	30·6	12·4	93	86·2	34·8	153	141·9	57·3	213	197·5	79·8	273	253·1	102·3
34	31·5	12·7	94	87·2	35·2	154	142·8	57·7	214	198·4	80·2	274	254·0	102·6
35	32·5	13·1	95	88·1	35·6	155	143·7	58·1	215	199·3	80·5	275	255·0	103·0
36	33·4	13·5	96	89·0	36·0	156	144·6	58·4	216	200·3	80·9	276	255·9	103·4
37	34·3	13·9	97	89·9	36·3	157	145·6	58·8	217	201·2	81·3	277	256·8	103·8
38	35·2	14·2	98	90·9	36·7	158	146·5	59·2	218	202·1	81·7	278	257·8	104·1
39	36·2	14·6	99	91·8	37·1	159	147·4	59·6	219	203·1	82·0	279	258·7	104·5
40	37·1	15·0	100	92·7	37·5	160	148·3	59·9	220	204·0	82·4	280	259·6	104·9
41	38·0	15·4	101	93·6	37·8	161	149·3	60·3	221	204·9	82·8	281	260·5	105·3
42	38·9	15·7	102	94·6	38·2	162	150·2	60·7	222	205·8	83·2	282	261·5	105·6
43	39·9	16·1	103	95·5	38·6	163	151·1	61·1	223	206·8	83·5	283	262·4	106·0
44	40·8	16·5	104	96·4	39·0	164	152·1	61·4	224	207·7	83·9	284	263·3	106 4
45	41·7	16·9	105	97·4	39·3	165	153·0	61·8	225	208·6	84·3	285	264·2	106·8
46	42·7	17·2	106	98·3	39·7	166	153·9	62·2	226	209·5	84·7	286	265·2	107·1
47	43·6	17·6	107	99·2	40·1	167	154·8	62·6	227	210·5	85·0	287	266·1	107·5
48	44·5	18·0	108	100·1	40·5	168	155·8	62·9	228	211·4	85·4	288	267·0	107·9
49	45·4	18·4	109	101·1	40·8	169	156·7	63·3	229	212·3	85·8	289	268·0	108·3
50	46·4	18·7	110	102·0	41·2	170	157 6	63·7	230	213·3	86·2	290	268·9	108·6
51	47·3	19·1	111	102·9	41·6	171	158·5	64·1	231	214·2	86·5	291	269·8	109·0
52	48·2	19·5	112	103·8	42·0	172	159·5	64·4	232	215·1	86·9	292	270·7	109·4
53	49·1	19·9	113	104·8	42·3	173	160·4	64·8	233	216·0	87·3	293	271·7	109·8
54	50·1	20·2	114	105·7	42·7	174	161·3	65·2	234	217·0	87·7	294	272·6	110·1
55	51·0	20·6	115	106·6	43·1	175	162·3	65·6	235	217·9	88·0	295	273·5	110·5
56	51·9	21·0	116	107·6	43·5	176	163·2	65·9	236	218·8	88·4	296	274·4	110·9
57	52·8	21·4	117	108·5	43·8	177	164·1	66·3	237	219·7	88·8	297	275·4	111·3
58	53·8	21·7	118	109·4	44·2	178	165·0	66·7	238	220·7	89·2	298	276·3	111·6
59	54·7	22·1	119	110·3	44·6	179	166·0	67·1	239	221·6	89·5	299	277·2	112·0
60	55·6	22·5	120	111·3	45·0	180	166·9	67·4	240	222·5	89·9	300	278·2	112·4
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

68°=4h. 32m.

TABLE 2.

Traverse Table to 23 Degrees = 1h. 32m.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	0·9	0·4	61	56·2	23·8	121	111·4	47·3	181	166·6	70·7	241	221·8	94·2
2	1·8	0·8	62	57·1	24·2	122	112·3	47·7	182	167·5	71·1	242	222·8	94·5
3	2·8	1·2	63	58·0	24·6	123	113·2	48·1	183	168·5	71·5	243	223·7	94·9
4	3·7	1·6	64	58·9	25·0	124	114·1	48·5	184	169·4	71·9	244	224·6	95·3
5	4·6	2·0	65	59·8	25·4	125	115·1	48·8	185	170·3	72·3	245	225·5	95·7
6	5·5	2·3	66	60·8	25·8	126	116·0	49·2	186	171·2	72·7	246	226·4	96·1
7	6·4	2·7	67	61·7	26·2	127	116·9	49·6	187	172·1	73·1	247	227·4	96·5
8	7·4	3·1	68	62·6	26·6	128	117·8	50·0	188	173·1	73·5	248	228·3	96·9
9	8·3	3·5	69	63·5	27·0	129	118·7	50·4	189	174·0	73·8	249	229·2	97·3
10	9·2	3·9	70	64·4	27·4	130	119·7	50·8	190	174·9	74·2	250	230·1	97·7
11	10·1	4·3	71	65·4	27·7	131	120·6	51·2	191	175·8	74·6	251	231·0	98·1
12	11·0	4·7	72	66·3	28·1	132	121·5	51·6	192	176·7	75·0	252	232·0	98·5
13	12·0	5·1	73	67·2	28·5	133	122·4	52·0	193	177·7	75·4	253	232·9	98·9
14	12·9	5·5	74	68·1	28·9	134	123·3	52·4	194	178·6	75·8	254	233·8	99·2
15	13·8	5.9	75	69·0	29·3	135	124·3	52·7	195	179·5	76·2	255	234·7	99·6
16	14·7	6·3	76	70·0	29·7	136	125·2	53·1	196	180·4	76·6	256	235·6	100·0
17	15·6	6·6	77	70·9	30·1	137	126·1	53·5	197	181·3	77·0	257	236·6	100·4
18	16·6	7·0	78	71·8	30·5	138	127·0	53·9	198	182·3	77·4	258	237·5	100·8
19	17·5	7·4	79	72·7	30·9	139	128·0	54·3	199	183·2	77·8	259	238·4	101·2
20	18·4	7·8	80	73·6	31·3	140	128·9	54·7	200	184·1	78·1	260	239·3	101·6
21	19·3	8·2	81	74·6	31·6	141	129·8	55·1	201	185·0	78·5	261	240·3	102·0
22	20·3	8·6	82	75·5	32·0	142	130·7	55·5	202	185·9	78·9	262	241·2	102·4
23	21·2	9·0	83	76·4	32.4	143	131·6	55·9	203	186·9	79·3	263	242·1	102·8
24	22·1	9·4	84	77·3	32·8	144	132·6	56·3	204	187·8	79·7	264	243·0	103·2
25	23·0	9·8	85	78·2	33·2	145	133·5	56·7	205	188·7	80·1	265	243·9	103·5
26	23·9	10·2	86	79·2	33·6	146	134·4	57·0	206	189·6	80·5	266	244·9	103·9
27	24·9	10·5	87	80·1	34·0	147	135·3	57·4	207	190·5	80·9	267	245·8	104·3
28	25·8	10·9	88	81·0	34·4	148	136·2	57·8	208	191·5	81·3	268	246·7	104·7
29	26·7	11·3	89	81·9	34·8	149	137·2	58·2	209	192·4	81·7	269	247·6	105·1
30	27·6	11·7	90	82·8	35·2	150	138·1	58·6	210	193·3	82·1	270	248·5	105·5
31	28·5	12·1	91	83·8	35·6	151	139·0	59·0	211	194·2	82·4	271	249·5	105·9
32	29·5	12·5	92	84·7	35·9	152	139·9	59·4	212	195·1	82·8	272	250·4	106·3
33	30·4	12·9	93	85·6	36·3	153	140·8	59·8	213	196·1	83·2	273	251·3	106·7
34	31·3	13·3	94	86·5	36·7	154	141·8	60·2	214	197·0	83·6	274	252·2	107·1
35	32·2	13·7	95	87·4	37·1	155	142·7	60·6	215	197·9	84·0	275	253·1	107·5
36	33·1	14·1	96	88·4	37·5	156	143·6	61·0	216	198·8	84·4	276	254·1	107·8
37	34·1	14·5	97	89·3	37·9	157	144·5	61·3	217	199·7	84·8	277	255·0	108·2
38	35·0	14·8	98	90·2	38·3	158	145·4	61·7	218	200·7	85·2	278	255·9	108·6
39	35·9	15·2	99	91·1	38·7	159	146·4	62·1	219	201·6	85·6	279	256·8	109·0
40	36·8	15·6	100	92·1	39·1	160	147·3	62·5	220	202·5	86·0	280	257·7	109·4
41	37·7	16·0	101	93·0	39·5	161	148·2	62·9	221	203·4	86·4	281	258·7	109·8
42	38·7	16·4	102	93·9	39·9	162	149·1	63·3	222	204·4	86·7	282	259·6	110·2
43	39·6	16·8	103	94·8	40·2	163	150·0	63·7	223	205·3	87·1	283	260·5	110·6
44	40·5	17·2	104	95·7	40·6	164	151·0	64·1	224	206·2	87·5	284	261·4	111·0
45	41·4	17·6	105	96·7	41·0	165	151·9	64·5	225	207·1	87·9	285	262·3	111·4
46	42·3	18·0	106	97·6	41·4	166	152·8	64.9	226	208·0	88·3	286	263·3	111·7
47	43·3	18·4	107	98·5	41·8	167	153·7	65·3	227	209·0	88·7	287	264·2	112·1
48	44·2	18·8	108	99·4	42·2	168	154·6	65·6	228	209·9	89·1	288	265·1	112·5
49	45·1	19·1	109	100·3	42·6	169	155·6	66·0	229	210·8	89·5	289	266·0	112·9
50	46·0	19·5	110	101·3	43·0	170	156·5	66·4	230	211·7	89·9	290	266·9	113·3
51	46·9	19·9	111	102·2	43·4	171	157·4	66·8	231	212·6	90·3	291	267·9	113·7
52	47·9	20·3	112	103·1	43·8	172	158·3	67.2	232	213·6	90·6	292	268·8	114·1
53	48·8	20·7	113	104·0	44·2	173	159·2	67·6	233	214·5	91·0	293	269·7	114·5
54	49·7	21·1	114	104·9	44·5	174	160·2	68·0	234	215·4	91·4	294	270·6	114·9
55	50·6	21·5	115	105·9	44·9	175	161·1	68·4	235	216·3	91·8	295	271·5	115·3
56	51·5	21·9	116	106·8	45·3	176	162·0	68·8	236	217·2	92·2	296	272·5	115·7
57	52·5	22·3	117	107·7	45·7	177	162·9	69·2	237	218·2	92·6	297	273·4	116·0
58	53·4	22·7	118	108·6	46·1	178	163·8	69·5	238	219·1	93·0	298	274·3	116·4
59	54·3	23·1	119	109·5	46·5	179	164·8	69·9	239	220·0	93·4	299	275·2	116·8
60	55·2	23·4	120	110·5	46·9	180	165·7	70·3	240	220·9	93·8	300	276·2	117·2
Dist.	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

67° = 4h. 28m.

TABLE 2.

Traverse Table to 24 Degrees = 1 h. 36m.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	0·9	0·4	61	55·7	24·8	121	110·5	49·2	181	165·4	73·6	241	220·2	98·0
2	1·8	0·8	62	56·6	25·2	122	111·5	49·6	182	166·3	74·0	242	221·1	98·4
3	2·7	1·2	63	57·6	25·6	123	112·4	50·0	183	167·2	74·4	243	222·0	98·8
4	3·7	1·6	64	58·5	26·0	124	113·3	50·4	184	168·1	74·8	244	222·9	99·2
5	4·6	2·0	65	59·4	26·4	125	114·2	50·8	185	169·0	75·2	245	223·8	99·7
6	5·5	2·4	66	60·3	26·8	126	115·1	51·2	186	169·9	75·7	246	224·7	100·1
7	6·4	2·8	67	61·2	27·3	127	116·0	51·7	187	170·8	76·1	247	225·6	100·5
8	7·3	3·3	68	62·1	27·7	128	116·9	52·1	188	171·7	76·5	248	226·6	100·9
9	8·2	3·7	69	63·0	28·1	129	117·8	52·5	189	172·7	76·9	249	227·5	101·3
10	9·1	4·1	70	63·9	28·5	130	118.8	52.9	190	173·6	77·3	250	228·4	101·7
11	10·0	4·5	71	64·9	28·9	131	119·7	53·3	191	174·5	77·7	251	229·3	102·1
12	11·0	4·9	72	65·8	29·3	132	120·6	53·7	192	175·4	78·1	252	230·2	102·5
13	11·9	5·3	73	66·7	29·7	133	121·5	54·1	193	176·3	78·5	253	231·1	102·9
14	12·8	5·7	74	67·6	30·1	134	122·4	54·5	194	177·2	78·9	254	232·0	103·3
15	13·7	6·1	75	68·5	30·5	135	123·3	54·9	195	178·1	79.3	255	233·0	103·7
16	14·6	6·5	76	69·4	30·9	136	124·2	55·3	196	179·1	79·7	256	233·9	104·1
17	15·5	6·9	77	70·3	31·3	137	125·2	55·7	197	180·0	80·1	257	234·8	104·5
18	16·4	7·3	78	71·3	31·7	138	126·1	56·1	198	180·9	80·5	258	235·7	104·9
19	17·4	7·7	79	72·2	32·1	139	127·0	56·5	199	181·8	80·9	259	236·6	105·3
20	18·3	8·1	80	73·1	32·5	140	127·9	56·9	200	182·7	81·3	260	237·5	105·8
21	19·2	8·5	81	74·0	32·9	141	128·8	57·3	201	183·6	81·8	261	238·4	106·2
22	20·1	8·9	82	74·9	33·4	142	129·7	57·8	202	184·5	82·2	262	239·3	106·6
23	21·0	9·4	83	75·8	33·8	143	130·6	58·2	203	185·4	82.6	263	240·3	107·0
24	21·9	9·8	84	76·7	34·2	144	131·6	58·6	204	186·4	83·0	264	241·2	107·4
25	22·8	10·2	85	77·7	34·6	145	132·5	59·0	205	187·3	83·4	265	242·1	107·8
26	23·8	10·6	86	78·6	35·0	146	133·4	59·4	206	188·2	83·8	266	243·0	108·2
27	24·7	11·0	87	79·5	35·4	147	134·3	59·8	207	189·1	84·2	267	243·9	108·6
28	25·6	11·4	88	80·4	35·8	148	135·2	60·2	208	190·0	84·6	268	244·8	109·0
29	26·5	11·8	89	81·3	36·2	149	136·1	60·6	209	190·9	85·0	269	245.7	109·4
30	27·4	12·2	90	82·2	36·6	150	137·0	61·0	210	191·8	85·4	270	246·7	109·8
31	28·3	12·6	91	83·1	37·0	151	137·9	61·4	211	192·8	85·8	271	247·6	110·2
32	29·2	13·0	92	84·0	37·4	152	138·9	61·8	212	193·7	86·2	272	248·5	110·6
33	30·1	13·4	93	85·0	37·8	153	139·8	62·2	213	194·6	86·6	273	249·4	111·0
34	31·1	13·8	94	85·9	38·2	154	140·7	62·6	214	195·5	87·0	274	250·3	111·4
35	32·0	14·2	95	86·8	38·6	155	141·6	63·0	215	196·4	87·4	275	251·2	111·9
36	32·9	14·6	96	87·7	39·0	156	142·5	63·5	216	197·3	87·9	276	252·1	112·3
37	33·8	15·0	97	88·6	39·5	157	143·4	63·9	217	198·2	88·3	277	253·1	112·7
38	34·7	15·5	98	89·5	39·9	158	144·3	64·3	218	199·2	88·7	278	254·0	113·1
39	35·6	15·9	99	90·4	40·3	159	145·3	64·7	219	200·1	89·1	279	254·9	113·5
40	36·5	16·3	100	91·4	40·7	160	146·2	65·1	220	201·0	89·5	280	255·8	113·9
41	37·5	16·7	101	92·3	41·1	161	147·1	65·5	221	201·9	89·9	281	256·7	114·3
42	38·4	17·1	102	93·2	41·5	162	148·0	65·9	222	202·8	90·3	282	257·6	114·7
43	39·3	17·5	103	94·1	41·9	163	148·9	66·3	223	203·7	90·7	283	258·5	115·1
44	40·2	17·9	104	95·0	42·3	164	149·8	66·7	224	204·6	91·1	284	259·4	115·5
45	41·1	18·3	105	95·9	42·7	165	150·7	67·1	225	205·5	91·5	285	260·4	115·9
46	42·0	18·7	106	96·8	43·1	166	151·6	67·5	226	206·5	91·9	286	261·3	116·3
47	42·9	19·1	107	97·7	43·5	167	152·6	67·9	227	207·4	92·3	287	262·2	116·7
48	43·9	19·5	108	98·7	43·9	168	153·5	68·3	228	208·3	92·7	288	263·1	117·1
49	44·8	19·9	109	99·6	44·3	169	154·4	68·7	229	209·2	93·1	289	264·0	117·5
50	45·7	20·3	110	100·5	44·7	170	155·3	69·1	230	210·1	93·5	290	264·9	118·0
51	46·6	20·7	111	101·4	45·1	171	156.2	69·6	231	211·0	94·0	291	265·8	118·4
52	47·5	21·2	112	102·3	45·6	172	157.1	70·0	232	211·9	94·4	292	266·8	118·8
53	48·4	21·6	113	103·2	46·0	173	158·0	70·4	233	212·9	94·8	293	267·7	119·2
54	49·3	22·0	114	104·1	46·4	174	159·0	70·8	234	213·8	95·2	294	268·6	119·6
55	50·2	22·4	115	105·1	46·8	175	159·9	71·2	235	214·7	95·6	295	269·5	120·0
56	51·2	22·8	116	106·0	47·2	176	160·8	71·6	236	215·6	96·0	296	270·4	120·4
57	52·1	23·2	117	106·9	47·6	177	161·7	72·0	237	216·5	96·4	297	271·3	120·8
58	53·0	23·6	118	107·8	48·0	178	162·6	72·4	238	217·4	96·8	298	272·2	121·2
59	53·9	24·0	119	108·7	48·4	179	163·5	72·8	239	218·3	97·2	299	273·2	121·6
60	54·8	24·4	120	109·6	48·8	180	164·4	73·2	240	219·3	97·6	300	274·1	122·0
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

TABLE 2.

Traverse Table to 25 Degrees=1h. 40m.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	0·9	0·4	61	55·3	25·8	121	109·7	51·1	181	164·0	76·5	241	218·4	101·9
2	1·8	0·8	62	56·2	26·2	122	110·6	51·6	182	164·9	76·9	242	219·3	102·3
3	2·7	1·3	63	57·1	26·6	123	111·5	52·0	183	165·9	77·3	243	220·2	102·7
4	3·6	1·7	64	58·0	27·0	124	112·4	52·4	184	166·8	77·8	244	221·1	103·1
5	4·5	2·1	65	58·9	27·5	125	113·3	52·8	185	167·7	78·2	245	222·0	103·5
6	5·4	2·5	66	59·8	27·9	126	114·2	53·2	186	168·6	78·6	246	223·0	104·0
7	6·3	3·0	67	60·7	28·3	127	115·1	53·7	187	169·5	79·0	247	223·9	104·4
8	7·3	3·4	68	61·6	28·7	128	116·0	54·1	188	170·4	79·5	248	224·8	104·8
9	8·2	3·8	69	62·5	29·2	129	116·9	54·5	189	171·3	79·9	249	225·7	105·2
10	9·1	4·2	70	63·4	29·6	130	117·8	54·9	190	172·2	80·3	250	226·6	105·7
11	10·0	4·6	71	64·3	30·0	131	118·7	55·4	191	173·1	80·7	251	227·5	106·1
12	10·9	5·1	72	65·3	30·4	132	119·6	55·8	192	174·0	81·1	252	228·4	106·5
13	11·8	5·5	73	66·2	30·9	133	120·5	56·2	193	174·9	81·6	253	229·3	106·9
14	12·7	5 9	74	67·1	31·3	134	121·4	56. 6	194	175·8	82·0	254	230·2	107·3
15	13·6	6·3	75	68·0	31·7	135	122·4	57·1	195	176·7	82·4	255	231·1	107·8
16	14·5	6·8	76	68·9	32·1	136	123·3	57·5	196	177·6	82·8	256	232·0	108·2
17	15·4	7·2	77	69·8	32·5	137	124·2	57·9	197	178·5	83·3	257	232·9	108·6
18	16·3	7·6	78	70·7	33·0	138	125·1	58·3	198	179·4	83·7	258	233·8	109·0
19	17·2	8·0	79	71·6	33·4	139	126·0	58·7	199	180·4	84·1	259	234·7	109·5
20	18·1	8·5	80	72·5	33·8	140	126·9	59·2	200	181·3	84·5	260	235·6	109·9
21	19·0	8·9	81	73·4	34·2	141	127·8	59·6	201	182·2	84·9	261	236·5	110·3
22	19·9	9·3	82	74·3	34·7	142	128·7	60·0	202	183·1	85·4	262	237·5	110·7
23	20·8	9·7	83	75·2	35·1	143	129·6	60·4	203	184·0	85·8	263	238·4	111·1
24	21·8	10·1	84	76·1	35·5	144	130·5	60·9	204	184·9	86·2	264	239·3	111·6
25	22·7	10·6	85	77·0	35·9	145	131·4	61·3	205	185·8	86·6	265	240·2	112·0
26	23·6	11·0	86	77·9	36·3	146	132·3	61·7	206	186·7	87·1	266	241·1	112·4
27	24·5	11·4	87	78·8	36·8	147	133·2	62·1	207	187·6	87·5	267	242·0	112·8
28	25·4	11·8	88	79·8	37·2	148	134·1	62·5	208	188·5	87·9	268	242·9	113·3
29	26·3	12·3	89	80·7	37·6	149	135·0	63·0	209	189·4	88·3	269	243·8	113·7
30	27·2	12·7	90	81·6	38·0	150	135·9	63·4	210	190·3	88·7	270	244·7	114·1
31	28·1	13·1	91	82·5	38·5	151	136·9	63·8	211	191·2	89·2	271	245·6	114·5
32	29·0	13·5	92	83·4	38·9	152	137·8	64·2	212	192·1	89·6	272	246·5	115·0
33	29·9	13·9	93	84·3	39·3	153	138·7	64·7	213	193·0	90·0	273	247·4	115·4
34	30·8	14·4	94	85·2	39·7	154	139·6	65·1	214	193·9	90·4	274	248·3	115·8
35	31·7	14·8	95	86·1	40·1	155	140·5	65·5	215	194·9	90·9	275	249·2	116·2
36	32·6	15·2	96	87·0	40·6	156	141·4	65·9	216	195·8	91·3	276	250·1	116·6
37	33·5	15·6	97	87·9	41·0	157	142·3	66·4	217	196·7	91·7	277	251·0	117·1
38	34·4	16·1	98	88·8	41·4	158	143·2	66·8	218	197·6	92·1	278	252·0	117·5
39	35·3	16·5	99	89·7	41·8	159	144·1	67·2	219	198·5	92·6	279	252·9	117·9
40	36·3	16·9	100	90·6	42·3	160	145·0	67·6	220	199·4	93·0	280	253·8	118·3
41	37·2	17·3	101	91·5	42·7	161	145·9	68·0	221	200·3	93·4	281	254·7	118·8
42	38·1	17·7	102	92·4	43·1	162	146·8	68·5	222	201·2	93·8	282	255·6	119·2
43	39·0	18·2	103	93·3	43·5	163	147·7	68·9	223	202·1	94·2	283	256·5	119·6
44	39·9	18·6	104	94·3	44·0	164	148·6	69·3	224	203·0	94·7	284	257·4	120·0
45	40·8	19·0	105	95·2	44·4	165	149·5	69·7	225	203·9	95·1	285	258·3	120·4
46	41·7	19·4	106	96·1	44·8	166	150·4	70·2	226	204·8	95·5	286	259·2	120·9
47	42·6	19·9	107	97·0	45·2	167	151·4	70·6	227	205·7	95·9	287	260·1	121·3
48	43·5	20·3	108	97·9	45·6	168	152·3	71·0	228	206·6	96·4	288	261·0	121·7
49	44·4	20·7	109	98·8	46·1	169	153·2	71·4	229	207·5	96·8	289	261·9	122·1
50	45·3	21·1	110	99·7	46·5	170	154·1	71·8	230	208·5	97·2	290	262·8	122·6
51	46·2	21·6	111	100·6	46·9	171	155·0	72·3	231	209·4	97·6	291	263·7	123·0
52	47·1	22·0	112	101·5	47·3	172	155·9	72·7	232	210·3	98·0	292	264·6	123·4
53	48·0	22·4	113	102·4	47·8	173	156·8	73·1	233	211·2	98·5	293	265·5	123·8
54	48·9	22·8	114	103·3	48·2	174	157·7	73·5	234	212·1	98·9	294	266·5	124·2
55	49·8	23·2	115	104·2	48·6	175	158·6	74·0	235	213·0	99·3	295	267·4	124·7
56	50·8	23·7	116	105·1	49·0	176	159·5	74·4	236	213·9	99·7	296	268·3	125·1
57	51·7	24·1	117	106·0	49·4	177	160·4	74·8	237	214·8	100·2	297	269·2	125·5
58	52·6	24·5	118	106·9	49·9	178	161·3	75·2	238	215·7	100·6	298	270·1	125·9
59	53·5	24·9	119	107·9	50·3	179	162·2	75·6	239	216·6	101·0	299	271·0	126 4
60	54·4	25·4	120	108·8	50·7	180	163·1	76·1	240	217·5	101·4	300	271·9	126·8
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

TABLE 2.

Traverse Table to 26 Degrees = 1h. 44m.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	0·9	0·4	61	54·8	26·7	121	108·8	53·0	181	162·7	79·3	241	216·6	105·6
2	1·8	0·9	62	55·7	27·2	122	109·7	53·5	182	163·6	79·8	242	217·5	106·1
3	2·7	1·3	63	56·6	27·6	123	110·6	53·9	183	164·5	80·2	243	218·4	106·5
4	3·6	1·8	64	57·5	28·1	124	111·5	54·4	184	165·4	80·7	244	219·3	107·0
5	4·5	2·2	65	58·4	28·5	125	112·3	54·8	185	166·3	81·1	245	220·2	107·4
6	5·4	2·6	66	59·3	28·9	126	113·2	55·2	186	167·2	81·5	246	221·1	107·8
7	6·3	3·1	67	60·2	29·4	127	114·1	55·7	187	168·1	82·0	247	222·0	108·3
8	7·2	3·5	68	61·1	29·8	128	115·0	56·1	188	169·0	82·4	248	222·9	108·7
9	8·1	3·9	69	62·0	30·2	129	115·9	56·5	189	169·9	82·9	249	223·8	109·2
10	9·0	4·4	70	62·9	30·7	130	116·8	57·0	190	170·8	83·3	250	224·7	109·6
11	9·9	4·8	71	63·8	31·1	131	117·7	57·4	191	171·7	83·7	251	225·6	110·0
12	10·8	5·3	72	64·7	31·6	132	118·6	57·9	192	172·6	84·2	252	226·5	110·5
13	11·7	5·7	73	65·6	32·0	133	119·5	58·3	193	173·5	84·6	253	227·4	110·9
14	12·6	6·1	74	66·5	32·4	134	120·4	58·7	194	174·4	85·0	254	228·3	111·3
15	13·5	6·6	75	67·4	32·9	135	121·3	59·2	195	175·3	85·5	255	229·2	111·8
16	14·4	7·0	76	68·3	33·3	136	122·2	59·6	196	176·2	85·9	256	230·1	112·2
17	15·3	7·5	77	69·2	33·8	137	123·1	60·1	197	177·1	86·4	257	231·0	112·7
18	16·2	7·9	78	70·1	34·2	138	124·0	60·5	198	178·0	86·8	258	231·9	113·1
19	17·1	8·3	79	71·0	34·6	139	124·9	60·9	199	178·9	87·2	259	232·8	113·5
20	18·0	8·8	80	71·9	35·1	140	125.8	61·4	200	179·8	87·7	260	233·7	114·0
21	18·9	9·2	81	72·8	35·5	141	126·7	61·8	201	180·7	88·1	261	234·6	114·4
22	19·8	9·6	82	73·7	35·9	142	127·6	62·2	202	181·6	88·6	262	235·5	114·9
23	20·7	10·1	83	74·6	36·4	143	128·5	62·7	203	182·5	89·0	263	236·4	115·3
24	21·6	10·5	84	75·5	36·8	144	129·4	63·1	204	183·4	89·4	264	237·3	115·7
25	22·5	11·0	85	76·4	37·3	145	130·3	63·6	205	184·3	89·9	265	238·2	116·2
26	23·4	11·4	86	77·3	37·7	146	131·2	64·0	206	185·2	90·3	266	239·1	116·6
27	24·3	11·8	87	78·2	38·1	147	132·1	64·4	207	186·1	90·7	267	240·0	117·0
28	25·2	12·3	88	79·1	38·6	148	133·0	64·9	208	186·9	91·2	268	240·9	117·5
29	26·1	12·7	89	80·0	39·0	149	133·9	65·3	209	187·8	91·6	269	241·8	117·9
30	27·0	13·2	90	80·9	39·5	150	134·8	65·8	210	188·7	92·1	270	242·7	118·4
31	27·9	13·6	91	81·8	39·9	151	135·7	66·2	211	189·6	92·5	271	243·6	118·8
32	28·8	14·0	92	82·7	40·3	152	136·6	66·6	212	190·5	92·9	272	244·5	119·2
33	29·7	14·5	93	83·6	40·8	153	137·5	67·1	213	191·4	93·4	273	245·4	119·7
34	30·6	14·9	94	84·5	41·2	154	138·4	67·5	214	192·3	93·8	274	246·3	120·1
35	31·5	15·3	95	85·4	41·6	155	139·3	67·9	215	193·2	94·2	275	247·2	120·6
36	32·4	15·8	96	86·3	42·1	156	140·2	68·4	216	194·1	94·7	276	248·1	121·0
37	33·3	16·2	97	87·2	42·5	157	141·1	68·8	217	195·0	95·1	277	249·0	121·4
38	34·2	16·7	98	88·1	43·0	158	142·0	69·3	218	195·9	95·6	278	249·9	121·9
39	35·1	17·1	99	89·0	43·4	159	142·9	69·7	219	196·8	96·0	279	250·8	122·3
40	36·0	17·5	100	89·9	43·8	160	143·8	70·1	220	197·7	96·4	280	251·7	122·7
41	36·9	18·0	101	90·8	44·3	161	144·7	70·6	221	198·6	96·9	281	252·6	123·2
42	37·7	18·4	102	91·7	44·7	162	145·6	71·0	222	199·5	97·3	282	253·5	123·6
43	38·6	18·8	103	92·6	45·2	163	146·5	71·5	223	200·4	97·8	283	254·4	124·1
44	39·5	19·3	104	93·5	45·6	164	147·4	71·9	224	201·3	98·2	284	255·3	124·5
45	40·4	19·7	105	94·4	46·0	165	148·3	72·3	225	202·2	98·6	285	256·2	124·9
46	41·3	20·2	106	95·3	46·5	166	149·2	72·8	226	203·1	99·1	286	257·1	125·4
47	42·2	20·6	107	96·2	46·9	167	150·1	73·2	227	204·0	99·5	287	258·0	125·8
48	43·1	21·0	108	97·1	47·3	168	151·0	73·6	228	204·9	99·9	288	258·9	126·3
49	44·0	21·5	109	98·0	47·8	169	151·9	74·1	229	205·8	100·4	289	259·8	126·7
50	44·9	21·9	110	98·9	48·2	170	152·8	74·5	230	206·7	100·8	290	260·7	127·1
51	45·8	22·4	111	99·8	48·7	171	153·7	75·0	231	207·6	101·3	291	261·5	127·6
52	46·7	22·8	112	100·7	49·1	172	154·6	75·4	232	208·5	101·7	292	262·4	128·0
53	47·6	23·2	113	101·6	49·5	173	155·5	75·8	233	209·4	102·1	293	263·3	128·4
54	48·5	23·7	114	102·5	50·0	174	156·4	76·3	234	210·3	102·6	294	264·2	128·9
55	49·4	24·1	115	103·4	50·4	175	157·3	76·7	235	211·2	103·0	295	265·1	129·3
56	50·3	24·5	116	104·3	50·9	176	158·2	77·2	236	212·1	103·5	296	266·0	129·8
57	51·2	25·0	117	105·2	51·3	177	159·1	77·6	237	213·0	103·9	297	266·9	130·2
58	52·1	25·4	118	106·1	51·7	178	160·0	78·0	238	213·9	104·3	298	267·8	130·6
59	53·0	25·9	119	107·0	52·2	179	160·9	78·5	239	214·8	104·8	299	268·7	131·1
60	53·9	26·3	120	107·9	52·6	180	161·8	78·9	240	215·7	105·2	300	269·6	131·5
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

64° = 4h. 16m.

TABLE 2.

Traverse Table to 27 Degrees = 1h. 48m.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	0·9	0·5	61	54·4	27·7	121	107·8	54·9	181	161·3	82·2	241	214·7	109·4
2	1·8	0·9	62	55·2	28·1	122	108·7	55·4	182	162·2	82·6	242	215·6	109·9
3	2·7	1·4	63	56·1	28·6	123	109·6	55·8	183	163·1	83·1	243	216·5	110·3
4	3·6	1·8	64	57·0	29·1	124	110·5	56·3	184	163·9	83·5	244	217·4	110·8
5	4·5	2·3	65	57·9	29·5	125	111·4	56·7	185	164·8	84·0	245	218·3	111·2
6	5·3	2·7	66	58·8	30·0	126	112·3	57·2	186	165·7	84·4	246	219·2	111·7
7	6·2	3·2	67	59·7	30·4	127	113·2	57·7	187	166·6	84·9	247	220·1	112·1
8	7·1	3·6	68	60·6	30·9	128	114·0	58·1	188	167·5	85·4	248	221·0	112.6
9	8·0	4·1	69	61·5	31·3	129	114·9	58·6	189	168·4	85·8	249	221·9	113·0
10	8·9	4·5	70	62·4	31·8	130	115·8	59·0	190	169·3	86·3	250	222·8	113·5
11	9·8	5·0	71	63·3	32·2	131	116·7	59·5	191	170·2	86·7	251	223·6	114·0
12	10·7	5·4	72	64·2	32·7	132	117·6	59·9	192	171·1	87·2	252	224·5	114·4
13	11·6	5·9	73	65·0	33·1	133	118·5	60·4	193	172·0	87·6	253	225·4	114·9
14	12·5	6·4	74	65·9	33·6	134	119·4	60·8	194	172·9	88·1	254	226·3	115·3
15	13·4	6·8	75	66·8	34·0	135	120·3	61·3	195	173·7	88·5	255	227·2	115·8
16	14·3	7·3	76	67·7	34·5	136	121·2	61·7	196	174·6	89·0	256	228·1	116·2
17	15·1	7·7	77	68·6	35·0	137	122·1	62·2	197	175·5	89·4	257	229·0	116·7
18	16·0	8·2	78	69·5	35·4	138	123·0	62·7	198	176·4	89·9	258	229·9	117·1
19	16·9	8·6	79	70·4	35·9	139	123·8	63·1	199	177·3	90·3	259	230·8	117·6
20	17·8	9·1	80	71·3	36·3	140	124·7	63·6	200	178·2	90·8	260	231·7	118·0
21	18·7	9·5	81	72·2	36·8	141	125·6	64·0	201	179·1	91·3	261	232·6	118·5
22	19·6	10·0	82	73·1	37·2	142	126·5	64·5	202	180·0	91·7	262	233·4	118·9
23	20·5	10·4	83	74·0	37·7	143	127·4	64·9	203	180·9	92·2	263	234·3	119·4
24	21·4	10·9	84	74·8	38·1	144	128·3	65·4	204	181·8	92·6	264	235·2	119·9
25	22·3	11·3	85	75·7	38·6	145	129·2	65·8	205	182·7	93·1	265	236·1	120·3
26	23·2	11·8	86	76·6	39·0	146	130·1	66·3	206	183·5	93·5	266	237·0	120·8
27	24·1	12·3	87	77·5	39·5	147	131·0	66·7	207	184·4	94·0	267	237·9	121·2
28	24·9	12·7	88	78·4	40·0	148	131·9	67·2	208	185·3	94·4	268	238·8	121·7
29	25·8	13·2	89	79·3	40·4	149	132·8	67·6	209	186·2	94·9	269	239·7	122·1
30	26·7	13·6	90	80·2	40·9	150	133·7	68·1	210	187·1	95·3	270	240·6	122·6
31	27·6	14·1	91	81·1	41·3	151	134·5	68·6	211	188·0	95·8	271	241·5	123·0
32	28·5	14·5	92	82·0	41·8	152	135·4	69·0	212	188·9	96·2	272	242·4	123·5
33	29·4	15·0	93	82·9	42·2	153	136·3	69·5	213	189·8	96·7	273	243·2	123·9
34	30·3	15·4	94	83.8	42·7	154	137·2	69·9	214	190·7	97·2	274	244·1	124·4
35	31·2	15·9	95	84·6	43·1	155	138·1	70·4	215	191·6	97·6	275	245·0	124·8
36	32·1	16·3	96	85·5	43·6	156	139·0	70·8	216	192·5	98·1	276	245·9	125·3
37	33·0	16·8	97	86·4	44·0	157	139·9	71·3	217	193·3	98·5	277	246·8	125·8
38	33·9	17·3	98	87·3	44·5	158	140·8	71·7	218	194·2	99·0	278	247·7	126·2
39	34·7	17·7	99	88·2	44·9	159	141·7	72·2	219	195·1	99·4	279	248·6	126·7
40	35·6	18·2	100	89·1	45·4	160	142·6	72 6	220	196·0	99·9	280	249·5	127·1
41	36·5	18·6	101	90·0	45·9	161	143·5	73·1	221	196·9	100·3	281	250·4	127·6
42	37·4	19·1	102	90·9	46·3	162	144·3	73·5	222	197·8	100·8	282	251·3	128·0
43	38·3	19·5	103	91·8	46·6	163	145·2	74·0	223	198·7	101·2	283	252·2	128·5
44	39·2	20·0	104	92·7	47·2	164	146·1	74·5	224	199·6	101·7	284	253·0	128·9
45	40·1	20·4	105	93·6	47·7	165	147·0	74·9	225	200·5	102·1	285	253·9	129·4
46	41·0	20·9	106	94·4	48·1	166	147·9	75·4	226	201·4	102·6	286	254·8	129·8
47	41·9	21·3	107	95·3	48·6	167	148·8	75·8	227	202·3	103·1	287	255·7	130·3
48	42·8	21·8	108	96·2	49·0	168	149·7	76·3	228	203·1	103·5	288	256·6	130·7
49	43·7	22·2	109	97·1	49·5	169	150·6	76·7	229	204·0	104·0	289	257·5	131·2
50	44·6	22·7	110	98·0	49·9	170	151·5	77·2	230	204·9	104·4	290	258·4	131·7
51	45·4	23·2	111	98·9	50·4	171	152·4	77·6	231	205·8	104·9	291	259·3	132·1
52	46·3	23·6	112	99·8	50·8	172	153·3	78·1	232	206·7	105·3	292	260·2	132·6
53	47·2	24·1	113	100·7	51·3	173	154·1	78·5	233	207·6	105·8	293	261·1	133·0
54	48·1	24·5	114	101·6	51·8	174	155·0	79·0	234	208·5	106·2	294	262·0	133·5
55	49·0	25·0	115	102·5	52·2	175	155·9	79·4	235	209·4	106·7	295	262·8	133·9
56	49·9	25·4	116	103·4	52·7	176	156·8	79·9	236	210·3	107·1	296	263·7	134·4
57	50·8	25·9	117	104·2	53·1	177	157·7	80·4	237	211·2	107·6	297	264·6	134·8
58	51·7	26·3	118	105·1	53·6	178	158·6	80·8	238	212·1	108·0	298	265·5	135·3
59	52·6	26·8	119	106·0	54·0	179	159·5	81·3	239	213·0	108·5	299	266·4	135·7
60	53·5	27·2	120	106·9	54·5	180	160·4	81·7	240	213·8	109·0	300	267·3	136·2
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

63° = 4h. 12m.

TABLE 2.

Traverse Table to 28 Degrees=1h. 52m.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	0·9	0·5	61	53·9	28·6	121	106·8	56·8	181	159·8	85·0	241	212·8	113·1
2	1·8	0·9	62	54·7	29·1	122	107·7	57·3	182	160·7	85·4	242	213·7	113·6
3	2·6	1·4	63	55·6	29·6	123	108·6	57·7	183	161·6	85·9	243	214·6	114·1
4	3·5	1·9	64	56·5	30·0	124	109·5	58·2	184	162·5	86·4	244	215·4	114·6
5	4·4	2·3	65	57·4	30·5	125	110·4	58·7	185	163·3	86·9	245	216·3	115·0
6	5·3	2·8	66	58·3	31·0	126	111·3	59·2	186	164·2	87·3	246	217·2	115·5
7	6·2	3·3	67	59·2	31·5	127	112·1	59·6	187	165·1	87·8	247	218·1	116·0
8	7·1	3·8	68	60·0	31·9	128	113·0	60·1	188	166·0	88·3	248	219·0	116·4
9	7·9	4·2	69	60·9	32·4	129	113·9	60·6	189	166·9	88·7	249	219·9	116·9
10	8·8	4·7	70	61·8	32·9	130	114·8	61·0	190	167·8	89·2	250	220·7	117·4
11	9·7	5·2	71	62·7	33·3	131	115·7	61·5	191	168·6	89·7	251	221·6	117·9
12	10·6	5·6	72	63·6	33·8	132	116·5	62·0	192	169·5	90·1	252	222·5	118·3
13	11·5	6·1	73	64·5	34·3	133	117·4	62·4	193	170·4	90·6	253	223·4	118·8
14	12·4	6·6	74	65·3	34·7	134	118·3	62·9	194	171·3	91·1	254	224·3	119·2
15	13·2	7·0	75	66·2	35·2	135	119·2	63·4	195	172·2	91·5	255	225·2	119·7
16	14·1	7·5	76	67·1	35·7	136	120·1	63·8	196	173·1	92·0	256	226·0	120·2
17	15·0	8·0	77	68·0	36·1	137	121·0	64·3	197	173·9	92·5	257	226·9	120·7
18	15·9	8·5	78	68·9	36·6	138	121·8	64·8	198	174·8	93·0	258	227·8	121·1
19	16·8	8·9	79	69·8	37·1	139	122·7	65·3	199	175·7	93·4	259	228·7	121·6
20	17·7	9·4	80	70·6	37·6	140	123·6	65·7	200	176·6	93·9	260	229·6	122·1
21	18·5	9·9	81	71·5	38·0	141	124·5	66·2	201	177·5	94·4	261	230·4	122·5
22	19·4	10·3	82	72·4	38·5	142	125·4	66·7	202	178·4	94·8	262	231·3	123·0
23	20·3	10·8	83	73·3	39·0	143	126·3	67·1	203	179·2	95·3	263	232·2	123·5
24	21·2	11·3	84	74·2	39·4	144	127·1	67·6	204	180·1	95·8	264	233·1	123·9
25	22·1	11·7	85	75·1	39·9	145	128·0	68·1	205	181·0	96·2	265	234·0	124·4
26	23·0	12·2	86	75·9	40·4	146	128·9	68·5	206	181·9	96·7	266	234·9	124·9
27	23·8	12·7	87	76·8	40·8	147	129·8	69·0	207	182·8	97·2	267	235·7	125·3
28	24·7	13·1	88	77·7	41·3	148	130·7	69·5	208	183·7	97·7	268	236·6	125·8
29	25·6	13·6	89	78·6	41·8	149	131·6	70·0	209	184·5	98·1	269	237·5	126·3
30	26·5	14·1	90	79·5	42·3	150	132·4	70·4	210	185·4	98·6	270	238·4	126·8
31	27·4	14·6	91	80·3	42·7	151	133·3	70·9	211	186·3	99·1	271	239·3	127·2
32	28·3	15·0	92	81·2	43·2	152	134·2	71·4	212	187·2	99·5	272	240·2	127·7
33	29·1	15·5	93	82·1	43·7	153	135·1	71·8	213	188·1	100·0	273	241·0	128·2
34	30·0	16·0	94	83·0	44·1	154	136·0	72·3	214	189·0	100·5	274	241·9	128·6
35	30·9	16·4	95	83·9	44·6	155	136·9	72·8	215	189·8	100·9	275	242·8	129·1
36	31·8	16·9	96	84·8	45·1	156	137·7	73·2	216	190·7	101·4	276	243·7	129·6
37	32·7	17·4	97	85·6	45·5	157	138·6	73·7	217	191·6	101·9	277	244·6	130·0
38	33·6	17·8	98	86·5	46·0	158	139·5	74·2	218	192·5	102·3	278	245·5	130·5
39	34·4	18·3	99	87·4	46·5	159	140·4	74·6	219	193·4	102·8	279	246·3	131·0
40	35·3	18·8	100	88·3	46·9	160	141·3	75·1	220	194·2	103·3	280	247·2	131·5
41	36·2	19·2	101	89·2	47·4	161	142·2	75·6	221	195·1	103·8	281	248·1	131.9
42	37·1	19·7	102	90·1	47·9	162	143·0	76·1	222	196·0	104·2	282	249·0	132·4
43	38·0	20·2	103	90·9	48·4	163	143·9	76·5	223	196·9	104·7	283	249·9	132·9
44	38·8	20·7	104	91·8	48·8	164	144·8	77·0	224	197·8	105·2	284	250·8	133·3
45	39·7	21·1	105	92·7	49·3	165	145·7	77·5	225	198·7	105·6	285	251·6	133·8
46	40·6	21·6	106	93·6	49·8	166	146·6	77·9	226	199·5	106·1	286	252·5	134.3
47	41·5	22·1	107	94·5	50·2	167	147·5	78·4	227	200·4	106·6	287	253·4	134·7
48	42·4	22·5	108	95·4	50·7	168	148·3	78·9	228	201·3	107·0	288	254·3	135·2
49	43·3	23·0	109	96·2	51·2	169	149·2	79·3	229	202·2	107·5	289	255·2	135·7
50	44·1	23·5	110	97·1	51·6	170	150·1	79·8	230	203·1	108·0	290	256·1	136·1
51	45·0	23·9	111	98·0	52·1	171	151·0	80·3	231	204·0	108·4	291	256·9	136·6
52	45·9	24·4	112	98·9	52·6	172	151·9	80·7	232	204·8	108·9	292	257·8	137·1
53	46·8	24·9	113	99·8	53·1	173	152·7	81·2	233	205·7	109·4	293	258·7	137·6
54	47·7	25·4	114	100·7	53·5	174	153·6	81·7	234	206·6	109·9	294	259·6	138·0
55	48·6	25·8	115	101·5	54·0	175	154·5	82·2	235	207·5	110·3	295	260·5	138·5
56	49·4	26·3	116	102·4	54·5	176	155·4	82·6	236	208·4	110·8	296	261·3	139·0
57	50·3	26·8	117	103·3	54·9	177	156·3	83·1	237	209·3	111·3	297	262·2	139·4
58	51·2	27·2	118	104·2	55·4	178	157·2	83·6	238	210·1	111·7	298	263·1	139·9
59	52·1	27·7	119	105·1	55·9	179	158·0	84·0	239	211·0	112·2	299	264·0	140·4
60	53·0	28·2	120	106·0	56·3	180	158·9	84·5	240	211·9	112·7	300	264·9	140·8
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

.62°=4h. 8m.

TABLE 2.

Traverse Table to 29 Degrees = 1h. 56m

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	0·9	0·5	61	53·4	29·6	121	105·8	58·7	181	158·3	87·8	241	210·8	116·8
2	1·7	1·0	62	54·2	30·1	122	106·7	59·1	182	159·2	88·2	242	211·7	117·3
3	2·6	1·5	63	55·1	30·5	123	107·6	59·6	183	160·1	88·7	243	212·5	117·8
4	3·5	1·9	64	56·0	31·0	124	108·5	60·1	184	160·9	89·2	244	213·4	118·3
5	4·4	2·4	65	56·9	31·5	125	109·3	60·6	185	161·8	89·7	245	214·3	118·8
6	5·2	2·9	66	57·7	32·0	126	110·2	61·1	186	162·7	90·2	246	215·2	119·3
7	6·1	3·4	67	58·6	32·5	127	111·1	61·6	187	163·6	90·7	247	216·0	119·7
8	7·0	3·9	68	59·5	33·0	128	112·0	62·1	188	164·4	91·1	248	216·9	120·2
9	7·9	4·4	69	60·3	33·5	129	112·8	62·5	189	165·3	91·6	249	217·8	120·7
10	8·7	4·8	70	61·2	33·9	130	113·7	63·0	190	166·2	92·1	250	218·7	121·2
11	9·6	5·3	71	62·1	34·4	131	114·6	63·5	191	167·1	92·6	251	219·5	121·7
12	10·5	5·8	72	63·0	34·9	132	115·4	64·0	192	167·9	93·1	252	220·4	122·2
13	11·4	6·3	73	63·8	35·4	133	116·3	64·5	193	168·8	93·6	253	221·3	122·7
14	12·2	6·8	74	64·7	35·9	134	117·2	65·0	194	169·7	94·1	254	222·2	123·1
15	13·1	7·3	75	65·6	36·4	135	118·1	65·4	195	170·6	94·5	255	223·0	123·6
16	14·0	7·8	76	66·5	36·8	136	118·9	65·9	196	171·4	95·0	256	223·9	124·1
17	14·9	8·2	77	67·3	37·3	137	119·8	66·4	197	172·3	95·5	257	224·8	124·6
18	15·7	8·7	78	68·2	37·8	138	120·7	66·9	198	173·2	96·0	258	225·7	125·1
19	16·6	9·2	79	69·1	38·3	139	121·6	67·4	199	174·0	96·5	259	226·5	125·6
20	17·5	9·7	80	70·0	38·8	140	122·4	67·9	200	174·9	97·0	260	227·4	126·1
21	18·4	10·2	81	70·8	39·3	141	123·3	68·4	201	175·8	97·4	261	228·3	126·5
22	19·2	10·7	82	71·7	39·8	142	124·2	68·8	202	176·7	97·9	262	229·2	127·0
23	20·1	11·2	83	72·6	40·2	143	125·1	69·3	203	177·5	98·4	263	230·0	127·5
24	21·0	11·6	84	73·5	40·7	144	125·9	69·8	204	178·4	98·9	264	230·9	128·0
25	21·9	12·1	85	74·3	41·2	145	126·8	70·3	205	179·3	99·4	265	231·8	128·5
26	22·7	12·6	86	75·2	41·7	146	127·7	70·8	206	180·2	99·9	266	232·6	129·0
27	23·6	13·1	87	76·1	42·2	147	128·6	71·3	207	181·0	100·4	267	233·5	129·4
28	24·5	13·6	88	77·0	42·7	148	129·4	71·8	208	181·9	100·8	268	234·4	129·9
29	25·4	14·1	89	77·8	43·1	149	130·3	72·2	209	182·8	101·3	269	235·3	130·4
30	26·2	14·5	90	78·7	43·6	150	131·2	72·7	210	183·7	101·8	270	236·1	130·9
31	27·1	15·0	91	79·6	44·1	151	132·1	73·2	211	184·5	102·3	271	237·0	131·4
32	28·0	15·5	92	80·5	44·6	152	132·9	73·7	212	185·4	102·8	272	237·9	131·9
33	28·9	16·0	93	81·3	45·1	153	133·8	74·2	213	186·3	103·3	273	238·8	132·4
34	29·7	16·5	94	82·2	45·6	154	134·7	74·7	214	187·2	103·7	274	239·6	132·8
35	30·6	17·0	95	83·1	46·1	155	135·6	75·1	215	188·0	104·2	275	240·5	133·3
36	31·5	17·5	96	84·0	46·5	156	136·4	75·6	216	188·9	104·7	276	241·4	133·8
37	32·4	17·9	97	84·8	47·0	157	137·3	76·1	217	189·8	105·2	277	242·3	134·3
38	33·2	18·4	98	85·7	47·5	158	138·2	76·6	218	190·7	105·7	278	243·1	134·8
39	34·1	18·9	99	86·6	48·0	159	139·1	77·1	219	191·5	106·2	279	244·0	135·3
40	35·0	19·4	100	87·5	48·5	160	139·9	77·6	220	192·4	106·7	280	244·9	135·7
41	35·9	19·9	101	88·3	49·0	161	140·8	78·1	221	193·3	107·1	281	245·8	136·2
42	36·7	20·4	102	89·2	49·5	162	141·7	78·5	222	194·2	107·6	282	246·6	136·7
43	37·6	20·8	103	90·1	49·9	163	142·6	79·0	223	195·0	108·1	283	247·5	137·2
44	38·5	21·3	104	91·0	50·4	164	143·4	79·5	224	195·9	108·6	284	248·4	137·7
45	39·4	21·8	105	91·8	50·9	165	144·3	80·0	225	196·8	109·1	285	249·3	138·2
46	40·2	22·3	106	92·7	51·4	166	145·2	80·5	226	197·7	109·6	286	250·1	138·7
47	41·1	22·8	107	93·6	51·9	167	146·1	81·0	227	198·5	110·1	287	251·0	139·1
48	42·0	23.3	108	94·5	52·4	168	146·9	81·4	228	199·4	110·5	288	251·9	139·6
49	42·9	23·8	109	95·3	52·8	169	147·8	81·9	229	200·3	111·0	289	252·8	140·1
50	43·7	24·2	110	96·2	53·3	170	148·7	82·4	230	201·2	111·5	290	253·6	140·6
51	44·6	24·7	111	97·1	53·8	171	149·6	82·9	231	202·0	112·0	291	254·5	141·1
52	45·5	25·2	112	98·0	54·3	172	150·4	83·4	232	202·9	112·5	292	255·4	141·6
53	46·4	25·7	113	98·8	54·8	173	151·3	83·9	233	203·8	113·0	293	256·3	142·0
54	47·2	26·2	114	99·7	55·3	174	152·2	84·4	234	204·7	113·4	294	257·1	142·5
55	48·1	26·7	115	100·6	55·8	175	153·1	84·8	235	205·5	113·9	295	258·0	143·0
56	49·0	27·1	116	101·5	56·2	176	153·9	85·3	236	206·4	114·4	296	258·9	143·5
57	49·9	27·6	117	102·3	56·7	177	154·8	85·8	237	207·3	114·9	297	259·8	144·0
58	50·7	28·1	118	103·2	57·2	178	155·7	86·3	238	208·2	115·4	298	260·6	144·5
59	51·6	28·6	119	104·1	57·7	179	156·6	86·8	239	209·0	115·9	299	261·5	145·0
60	52·5	29·1	120	105·0	58·2	180	157·4	87·3	240	209·9	116·4	300	262·4	145·4
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

TABLE 2.

Traverse Table to 30 Degrees = 2h. 0m.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	0·9	0·5	61	52·8	30·5	121	104·8	60·5	181	156·8	90·5	241	208·7	120·5
2	1·7	1·0	62	53·7	31·0	122	105·7	61·0	182	157·6	91·0	242	209·6	121·0
3	2·6	1·5	63	54·6	31·5	123	106·5	61·5	183	158·5	91·5	243	210·4	121·5
4	3·5	2·0	64	55·4	32·0	124	107·4	62·0	184	159·3	92·0	244	211·3	122·0
5	4·3	2·5	65	56·3	32·5	125	108·3	62·5	185	160·2	92·5	245	212·2	122·5
6	5·2	3·0	66	57·2	33·0	126	109·1	63·0	186	161·1	93·0	246	213·0	123·0
7	6·1	3·5	67	58·0	33·5	127	110·0	63·5	187	161·9	93·5	247	213·9	123·5
8	6·9	4·0	68	58·9	34·0	128	110·9	64·0	188	162·8	94·0	248	214·8	124·0
9	7·8	4·5	69	59·8	34·5	129	111·7	64·5	189	163·7	94·5	249	215·6	124·5
10	8·7	5·0	70	60·6	35·0	130	112·6	65·0	190	164·5	95·0	250	216·5	125·0
11	9·5	5·5	71	61·5	35·5	131	113·4	65·5	191	165·4	95·5	251	217·4	125·5
12	10·4	6·0	72	62·4	36·0	132	114·3	66·0	192	166·3	96·0	252	218·2	126·0
13	11·3	6·5	73	63·2	36·5	133	115·2	66·5	193	167·1	96·5	253	219·1	126·5
14	12·1	7·0	74	64·1	37·0	134	116·0	67·0	194	168·0	97·0	254	220·0	127·0
15	13·0	7·5	75	65·0	37·5	135	116·9	67·5	195	168·9	97·5	255	220·8	127·5
16	13·9	8·0	76	65·8	38·0	136	117·8	68·0	196	169·7	98·0	256	221·7	128·0
17	14·7	8·5	77	66·7	38·5	137	118·6	68·5	197	170·6	98·5	257	222·6	128·5
18	15·6	9·0	78	67·5	39·0	138	119·5	69·0	198	171·5	99·0	258	223·4	129·0
19	16·5	9·5	79	68·4	39·5	139	120·4	69·5	199	172·3	99·5	259	224·3	129·5
20	17·3	10·0	80	69·3	40·0	140	121·2	70·0	200	173·2	100·0	260	225·2	130·0
21	18·2	10·5	81	70·1	40·5	141	122·1	70·5	201	174·1	100·5	261	226·0	130·5
22	19·1	11·0	82	71·0	41·0	142	123·0	71·0	202	174·9	101·0	262	226·9	131·0
23	19·9	11·5	83	71·9	41·5	143	123·8	71·5	203	175·8	101·5	263	227·8	131·5
24	20·8	12·0	84	72·7	42·0	144	124·7	72·0	204	176·7	102·0	264	228·6	132·0
25	21·7	12·5	85	73·6	42·5	145	125·6	72·5	205	177·5	102·5	265	229·5	132·5
26	22·5	13·0	86	74·5	43·0	146	126·4	73·0	206	178·4	103·0	266	230·4	133·0
27	23·4	13·5	87	75·3	43·5	147	127·3	73·5	207	179·3	103·5	267	231·2	133·5
28	24·2	14·0	88	76·2	44·0	148	128·2	74·0	208	180·1	104·0	268	232·1	134·0
29	25·1	14·5	89	77·1	44·5	149	129·0	74·5	209	181·0	104·5	269	233·0	134·5
30	26·0	15·0	90	77·9	45·0	150	129·9	75·0	210	181·9	105·0	270	233·8	135·0
31	26·8	15·5	91	78·8	45·5	151	130·8	75·5	211	182·7	105·5	271	234·7	135·5
32	27·7	16·0	92	79·7	46·0	152	131·6	76·0	212	183·6	106·0	272	235·6	136·0
33	28·6	16·5	93	80·5	46·5	153	132·5	76·5	213	184·5	106·5	273	236·4	136·5
34	29·4	17·0	94	81·4	47·0	154	133·4	77·0	214	185·3	107·0	274	237·3	137·0
35	30·3	17·5	95	82·3	47·5	155	134·2	77·5	215	186·2	107·5	275	238·2	137·5
36	31·2	18·0	96	83·1	48·0	156	135·1	78·0	216	187·1	108·0	276	239·0	138·0
37	32·0	18·5	97	84·0	48·5	157	136·0	78·5	217	187·9	108·5	277	239·9	138·5
38	32·9	19·0	98	84·9	49·0	158	136·8	79·0	218	188·8	109·0	278	240·8	139·0
39	33·8	19·5	99	85·7	49·5	159	137·7	79·5	219	189·7	109·5	279	241·6	139·5
40	34·6	20·0	100	86·6	50·0	160	138·6	80·0	220	190·5	110·0	280	242·5	140·0
41	35·5	20·5	101	87·5	50·5	161	139·4	80·5	221	191·4	110·5	281	243·4	140·5
42	36·4	21·0	102	88·3	51·0	162	140·3	81·0	222	192·3	111·0	282	244·2	141·0
43	37·2	21·5	103	89·2	51·5	163	141·2	81·5	223	193·1	111·5	283	245·1	141·5
44	38·1	22·0	104	90·1	52·0	164	142·0	82·0	224	194·0	112·0	284	246·0	142·0
45	39·0	22·5	105	90·9	52·5	165	142·9	82·5	225	194·9	112·5	285	246·8	142·5
46	39·8	23·0	106	91·8	53·0	166	143·8	83·0	226	195·7	113·0	286	247·7	143·0
47	40·7	23·5	107	92·7	53·5	167	144·6	83·5	227	196·6	113·5	287	248·5	143·5
48	41·6	24·0	108	93·5	54·0	168	145·5	84·0	228	197·5	114·0	288	249·4	144·0
49	42·4	24·5	109	94·4	54·5	169	146·4	84·5	229	198·3	114·5	289	250·3	144·5
50	43·3	25·0	110	95·3	55·0	170	147·2	85·0	230	199·2	115·0	290	251·1	145·0
51	44·2	25·5	111	96·1	55·5	171	148·1	85·5	231	200·1	115·5	291	252·0	145·5
52	45·0	26·0	112	97·0	56·0	172	149·0	86·0	232	200·9	116·0	292	252·9	146·0
53	45·9	26·5	113	97·9	56·5	173	149·8	86·5	233	201·8	116·5	293	253·7	146·5
54	46·8	27·0	114	98·7	57·0	174	150·7	87·0	234	202·6	117·0	294	254·6	147·0
55	47·6	27·5	115	99·6	57·5	175	151·6	87·5	235	203·5	117·5	295	255·5	147·5
56	48·5	28·0	116	100·5	58·0	176	152·4	88·0	236	204·4	118·0	296	256·3	148·0
57	49·4	28·5	117	101·3	58·5	177	153·3	88·5	237	205·2	118·5	297	257·2	148·5
58	50·2	29·0	118	102·2	59·0	178	154·2	89·0	238	206·1	119·0	298	258·1	149·0
59	51·1	29·5	119	103·1	59·5	179	155·0	89·5	239	207·0	119·5	299	258·9	149·5
60	52·0	30·0	120	103·9	60·0	180	155·9	90·0	240	207·8	120·0	300	259·8	150·0
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

60° — 4h. 0m.

TABLE 2.

Traverse Table to 31 Degrees = 2h. 4m.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	0·9	0·5	61	52·3	31·4	121	103·7	62·3	181	155·1	93·2	241	206·6	124·1
2	1·7	1·0	62	53·1	31·9	122	104·6	62·8	182	156·0	93·7	242	207·4	124·6
3	2·6	1·5	63	54·0	32·4	123	105·4	63·3	183	156·9	94·3	243	208·3	125·2
4	3·4	2·1	64	54·9	33·0	124	106·3	63·9	184	157·7	94·8	244	209·1	125·7
5	4·3	2·6	65	55·7	33·5	125	107·1	64·4	185	158·6	95·3	245	210·0	126·2
6	5·1	3·1	66	56·6	34·0	126	108·0	64·9	186	159·4	95·8	246	210·9	126·7
7	6·0	3·6	67	57·4	34·5	127	108·9	65·4	187	160·3	96·3	247	211·7	127·2
8	6·9	4.1	68	58·3	35·0	128	109·7	65·9	188	161·1	96·8	248	212·6	127·7
9	7·7	4·6	69	59·1	35·5	129	110·6	66·4	189	162·0	97·3	249	213·4	128·2
10	8·6	5·2	70	60·0	36·1	130	111·4	67·0	190	162·9	97·9	250	214·3	128·8
11	9·4	5·7	71	60·9	36·6	131	112·3	67·5	191	163·7	98·4	251	215·1	129·3
12	10·3	6·2	72	61·7	37·1	132	113·1	68·0	192	164·6	98·9	252	216·0	129·8
13	11·1	6·7	73	62·6	37·6	133	114·0	68·5	193	165·4	99·4	253	216·9	130·3
14	12·0	7·2	74	63·4	38·1	134	114·9	69·0	194	166·3	99·9	254	217·7	130·8
15	12·9	7·7	75	64·3	38·6	135	115·7	69·5	195	167·1	100·4	255	218·6	131·3
16	13·7	8·2	76	65·1	39·1	136	116·6	70·0	196	168·0	100·9	256	219·4	131·8
17	14·6	8·8	77	66·0	39·7	137	117·4	70·6	197	168·9	101·5	257	220·3	132·4
18	15·4	9·3	78	66·9	40·2	138	118·3	71·1	198	169·7	102·0	258	221·1	132·9
19	16·3	9·8	79	67·7	40·7	139	119·1	71·6	199	170·6	102·5	259	222·0	133·4
20	17·1	10·3	80	68·6	41·2	140	120·0	72·1	200	171·4	103·0	260	222·9	133·9
21	18·0	10·8	81	69·4	41·7	141	120·9	72·6	201	172·3	103·5	261	223·7	134·4
22	18·9	11·3	82	70·3	42·2	142	121·7	73·1	202	173·1	104·0	262	224·6	134·9
23	19·7	11·8	83	71·1	42·7	143	122·6	73·7	203	174·0	104·6	263	225·4	135·5
24	20·6	12·4	84	72·0	43·3	144	123·4	74·2	204	174·9	105·1	264	226·3	136·0
25	21·4	12·9	85	72·9	43·8	145	124·3	74·7	205	175·7	105.6	265	227·1	136·5
26	22·3	13·4	86	73·7	44·3	146	125·1	75·2	206	176·6	106·1	266	228·0	137·0
27	23·1	13·9	87	74·6	44·8	147	126·0	75·7	207	177·4	106·6	267	228·9	137·5
28	24·0	14·4	88	75·4	45·3	148	126·9	76·2	208	178·3	107·1	268	229·7	138·0
29	24·9	14·9	89	76·3	45·8	149	127·7	76·7	209	179·1	107·6	269	230·6	138·5
30	25·7	15·5	90	77·1	46·4	150	128·6	77·3	210	180·0	108·2	270	231·4	139·1
31	26·6	16·0	91	78·0	46·9	151	129·4	77·8	211	180·9	108·7	271	232·3	139·6
32	27·4	16·5	92	78·9	47·4	152	130·3	78·3	212	181·7	109·2	272	233·1	140·1
33	28·3	17·0	93	79·7	47·9	153	131·1	78·8	213	182·6	109·7	273	234·0	140·6
34	29·1	17·5	94	80·6	48·4	154	132·0	79·3	214	183·4	110.2	274	234·9	141·1
35	30·0	18·0	95	81·4	48·9	155	132·9	79·8	215	184·3	110·7	275	235·7	141·6
36	30·9	18·5	96	82·3	49·4	156	133·7	80·3	216	185·1	111·2	276	236·6	142·2
37	31.7	19·1	97	83·1	50·0	157	134·6	80·9	217	186·0	111·8	277	237·4	142·7
38	32.6	19·6	98	84·0	50·5	158	135·4	81·4	218	186·9	112·3	278	238·3	143·2
39	33·4	20·1	99	84·9	51·0	159	136·3	81·9	219	187·7	112·8	279	239·1	143·7
40	34·3	20·6	100	85·7	51·5	160	137·1	82·4	220	188·6	113·3	280	240·0	144·2
41	35·1	21·1	101	86·6	52·0	161	138·0	82·9	221	189·4	113·8	281	240·9	144·7
42	36·0	21·6	102	87·4	52·5	162	138·9	83·4	222	190·3	114·3	282	241·7	145·2
43	36·9	22·1	103	88·3	53·0	163	139·7	84·0	223	191·1	114·9	283	242·6	145·8
44	37·7	22·7	104	89·1	53·6	164	140·6	84·5	224	192·0	115·4	284	243·4	146·3
45	38·6	23·2	105	90·0	54·1	165	141·4	85·0	225	192·9	115·9	285	244·3	146·8
46	39·4	23·7	106	90·9	54·6	166	142·3	85·5	226	193·7	116·4	286	245·1	147·3
47	40·3	24·2	107	91·7	55·1	167	143·1	86·0	227	194·6	116·9	287	246·0	147·8
48	41·1	24·7	108	92·6	55·6	168	144·0	86·5	228	195·4	117·4	288	246·9	148·3
49	42·0	25·2	109	93·4	56·1	169	144·9	87·0	229	196·3	117·9	289	247·7	148·8
50	42·9	25·8	110	94·3	56·7	170	145·7	87·6	230	197·1	118·5	290	248·6	149·4
51	43·7	26·3	111	95·1	57·2	171	146·6	88·1	231	198·0	119·0	291	249·4	149·9
52	44·6	26·8	112	96·0	57·7	172	147·4	88·6	232	198·9	119·5	292	250·3	150·4
53	45·4	27·3	113	96·9	58·2	173	148·3	89·1	233	199·7	120·0	293	251·2	150·9
54	46·3	27·8	114	97·7	58·7	174	149·1	89·6	234	200·6	120·5	294	252·0	151·4
55	47·1	28·3	115	98·6	59·2	175	150·0	90·1	235	201·4	121·0	295	252·9	151·9
56	48·0	28·8	116	99·4	59·7	176	150·9	90·6	236	202·3	121·5	296	253·7	152·5
57	48·9	29·4	117	100·3	60·3	177	151·7	91·2	237	203·1	122·1	297	254·6	153·0
58	49·7	29·9	118	101·1	60·8	178	152·6	91·7	238	204·0	122·6	298	255·4	153·5
59	50·6	30·4	119	102·0	61·3	179	153·4	92·2	239	204·9	123·1	299	256·3	154·0
60	51·4	30·9	120	102·9	61·8	180	154·3	92·7	240	205·7	123·6	300	257·1	154·5
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

TABLE 2.

Traverse Table to 32 Degrees = 2h. 8m.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	0·8	0·5	61	51·7	32·3	121	102·6	64·1	181	153·5	95·9	241	204·4	127·7
2	1·7	1·1	62	52·6	32·9	122	103·5	64·7	182	154·3	96·4	242	205·2	128·2
3	2·5	1·6	63	53·4	33·4	123	104·3	65·2	183	155·2	97·0	243	206·1	128·8
4	3·4	2·1	64	54·3	33·9	124	105·2	65·7	184	156·0	97·5	244	206·9	129·3
5	4·2	2·6	65	55·1	34·4	125	106·0	66·2	185	156·9	98·0	245	207·8	129·8
6	5·1	3·2	66	56·0	35·0	126	106·9	66·8	186	157·7	98·6	246	208·6	130·4
7	5·9	3·7	67	56·8	35·5	127	107·7	67·3	187	158·6	99·1	247	209·5	130·9
8	6·8	4·2	68	57·7	36·0	128	108·6	67·8	188	159·4	99·6	248	210·3	131·4
9	7·6	4·8	69	58·5	36·6	129	109·4	68·4	189	160·3	100·2	249	211·2	131·9
10	8·5	5·3	70	59·4	37·1	130	110·2	68·9	190	161·1	100·7	250	212·0	132·5
11	9·3	5·8	71	60·2	37·6	131	111·1	69·4	191	162·0	101·2	251	212·9	133·0
12	10·2	6·4	72	61·1	38·2	132	111·9	69·9	192	162·8	101·7	252	213·7	133·5
13	11·0	6·9	73	61·9	38·7	133	112·8	70·5	193	163·7	102·3	253	214·6	134·1
14	11·9	7·4	74	62·8	39·2	134	113·6	71·0	194	164·5	102·8	254	215·4	134·6
15	12·7	7·9	75	63·6	39·7	135	114·5	71·5	195	165·4	103·3	255	216·3	135·1
16	13·6	8·5	76	64·5	40·3	136	115·3	72·1	196	166·2	103·9	256	217·1	135·7
17	14·4	9·0	77	65·3	40·8	137	116·2	72·6	197	167·1	104·4	257	217·9	136·2
18	15·3	9·5	78	66·1	41·3	138	117·0	73·1	198	167·9	104·9	258	218·8	136·7
19	16·1	10·1	79	67·0	41·9	139	117·9	73·7	199	168·8	105·5	259	219·6	137·2
20	17·0	10·6	80	67·8	42·4	140	118·7	74·2	200	169·6	106·0	260	220·5	137·8
21	17·8	11·1	81	68·7	42·9	141	119·6	74·7	201	170·5	106·5	261	221·3	138·3
22	18·7	11·7	82	69·5	43·5	142	120·4	75·2	202	171·3	107·0	262	222·2	138·8
23	19·5	12·2	83	70·4	44·0	143	121·3	75·8	203	172·2	107·6	263	223·0	139·4
24	20·4	12·7	84	71·2	44·5	144	122·1	76·3	204	173·0	108·1	264	223.9	139·9
25	21·2	13·2	85	72·1	45·0	145	123·0	76·8	205	173·8	108·6	265	224·7	140·4
26	22·0	13·8	86	72·9	45·6	146	123·8	77·4	206	174·7	109·2	266	225·6	141·0
27	22·9	14·3	87	73·8	46·1	147	124·7	77·9	207	175·5	109·7	267	226·4	141·5
28	23·7	14·8	88	74·6	46·6	148	125·5	78·4	208	176·4	110·2	268	227·3	142·0
29	24·6	15·4	89	75·5	47·2	149	126·4	79·0	209	177·2	110·8	269	228·1	142·5
30	25·4	15·9	90	76·3	47·7	150	127·2	79·5	210	178·1	111·3	270	229·0	143·1
31	26·3	16·4	91	77·2	48·2	151	128·1	80·0	211	178·9	111·8	271	229·8	143·6
32	27·1	17·0	92	78·0	48·8	152	128·9	80·5	212	179·8	112·3	272	230·7	144·1
33	28·0	17·5	93	78·9	49·3	153	129·8	81·1	213	180·6	112·9	273	231·6	144·7
34	28·8	18·0	94	79·7	49·8	154	130·6	81·6	214	181·5	113·4	274	232·4	145·2
35	29·7	18·5	95	80·6	50·3	155	131·4	82·1	215	182·3	113·9	275	233·2	145·7
36	30·5	19·1	96	81·4	50·9	156	132·3	82·7	216	183·2	114·5	276	234·1	146·3
37	31·4	19·6	97	82·3	51·4	157	133·1	83·2	217	184·0	115·0	277	234·9	146·8
38	32·2	20·1	98	83·1	51·9	158	134·0	83·7	218	184·9	115·5	278	235·8	147·3
39	33·1	20·7	99	84·0	52·5	159	134·8	84·3	219	185·7	116·1	279	236·6	147·8
40	33·9	21·2	100	84·8	53·0	160	135·7	84·8	220	186·6	116·6	280	237·5	148·4
41	34·8	21·7	101	85·7	53·5	161	136·5	85·3	221	187·4	117·1	281	238·3	148·9
42	35·6	22·3	102	86·5	54·1	162	137·4	85·8	222	188·3	117·6	282	239·1	149·4
43	36·5	22·8	103	87·3	54·6	163	138·2	86·4	223	189·1	118·2	283	240·0	150·0
44	37·3	23·3	104	88·2	55·1	164	139·1	86·9	224	190·0	118·7	284	240·8	150·5
45	38·2	23·8	105	89·0	55·6	165	139·9	87·4	225	190·8	119·2	285	241·7	151·0
46	39·0	24·4	106	89·9	56·2	166	140·8	88·0	226	191·7	119·8	286	242·5	151·6
47	39·9	24·9	107	90·7	56·7	167	141·6	88·5	227	192·5	120·3	287	243·4	152·1
48	40·7	25·4	108	91·6	57·2	168	142·5	89·0	228	193·4	120·8	288	244·2	152·6
49	41·6	26·0	109	92·4	57·8	169	143·3	89·6	229	194·2	121·4	289	245·1	153·1
50	42·4	26·5	110	93·3	58·3	170	144·2	90·1	230	195·1	121·9	290	245·9	153·7
51	43·3	27·0	111	94·1	58·8	171	145·0	90·6	231	195·9	122·4	291	246·8	154·2
52	44·1	27·6	112	95·0	59·4	172	145·9	91·1	232	196·7	122·9	292	247·6	154·7
53	44·9	28·1	113	95·8	59·9	173	146·7	91·7	233	197·6	123·5	293	248·5	155·3
54	45·8	28·6	114	96·7	60·4	174	147·6	92·2	234	198·4	124·0	294	249·3	155·8
55	46·6	29·1	115	97·5	60·9	175	148·4	92·7	235	199·3	124·5	295	250·2	156·3
56	47·5	29·7	116	98·4	61·5	176	149·3	93·3	236	200·1	125·1	296	251·0	156·9
57	48·3	30·2	117	99·2	62·0	177	150·1	93·8	237	201·0	125·6	297	251·9	157·4
58	49·2	30·7	118	100·1	62·5	178	151·0	94·3	238	201·8	126·1	298	252·7	157·9
59	50·0	31·3	119	100·9	63·1	179	151·8	94·9	239	202·7	126·7	299	253·6	158·4
60	50·9	31·8	120	101·8	63·6	180	152·6	95·4	240	203·5	127·2	300	254·4	159·0
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

58° = 3h. 52m.

TABLE 2.

Traverse Table to 33 Degrees=2h. 12m.

Dist	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	0·8	0·5	61	51·2	33·2	121	101·5	65·9	181	151·8	98·6	241	202·1	131·3
2	1·7	1·1	62	52·0	33·8	122	102·3	66·4	182	152·6	99·1	242	203·0	131·8
3	2·5	1·6	63	52·8	34·3	123	103·2	67·0	183	153·5	99·7	243	203·8	132·3
4	3·4	2·2	64	53·7	34·9	124	104·0	67·5	184	154·3	100·2	244	204·6	132·9
5	4·2	2·7	65	54.5	35·4	125	104·8	68·1	185	155·2	100·8	245	205·5	133·4
6	5·0	3·3	66	55·4	35·9	126	105·7	68·6	186	156·0	101·3	246	206·3	134·0
7	5·9	3·8	67	56·2	36·5	127	106·5	69·2	187	156·8	101·8	247	207·2	134·5
8	6·7	4·4	68	57·0	37·0	128	107·3	69·7	188	157·7	102·4	248	208·0	135·1
9	7·5	4·9	69	57·9	37·6	129	108·2	70·3	189	158·5	102·9	249	208·8	135·6
10	8·4	5·4	70	58·7	38·1	130	109·0	70·8	190	159·3	103·5	250	209·7	136·2
11	9·2	6·0	71	59·5	38·7	131	109·9	71·3	191	160·2	104·0	251	210·5	136·7
12	10·1	6·5	72	60·4	39·2	132	110·7	71·9	192	161·0	104.6	252	211·3	137·2
13	10·9	7·1	73	61·2	39·8	133	111·5	72·4	193	161·9	105·1	253	212·2	137·8
14	11·7	7·6	74	62·1	40·3	134	112·4	73·0	194	162·7	105·7	254	213·0	138·3
15	12·6	8·2	75	62·9	40·8	135	113·2	73·5	195	163·5	106·2	255	213·9	138·9
16	13·4	8·7	76	63·7	41·4	136	114·1	74·1	196	164·4	106·7	256	214·7	139·4
17	14·3	9·3	77	64·6	41·9	137	114·9	74·6	197	165·2	107·3	257	215·5	140·0
18	15·1	9·8	78	65·4	42·5	138	115·7	75·2	198	166·1	107·8	258	216·4	140·5
19	15·9	10·3	79	66·3	43·0	139	116·6	75·7	199	166·9	108·4	259	217·2	141·1
20	16·8	10·9	80	67·1	43·6	140	117·4	76·2	200	167·7	108·9	260	218·1	141·6
21	17·6	11·4	81	67·9	44·1	141	118·3	76·8	201	168·6	109·5	261	218·9	142.2
22	18·5	12·0	82	68·8	44·7	142	119·1	77·3	202	169·4	110·0	262	219·7	142·7
23	19·3	12·5	83	69·6	45·2	143	119·9	77·9	203	170·3	110·6	263	220·6	143·2
24	20·1	13·1	84	70·4	45·7	144	120·8	78·4	204	171.1	111·1	264	221·4	143·8
25	21·0	13·6	85	71·3	46·3	145	121·6	79·0	205	171·9	111·7	265	222·2	144·3
26	21·8	14·2	86	72·1	46·8	146	122·4	79·5	206	172·8	112·2	266	223·1	144·9
27	22·6	14·7	87	73·0	47·4	147	123·3	80·1	207	173·6	112·7	267	223·9	145·4
28	23·5	15·2	88	73·8	47·9	148	124·1	80·6	208	174·4	113·3	268	224·8	146·0
29	24·3	15·8	89	74·6	48·5	149	125·0	81·2	209	175·3	113·8	269	225·6	146·5
30	25·2	16·3	90	75·5	49·0	150	125·8	81·7	210	176·1	114·4	270	226·4	147·1
31	26·0	16·9	91	76·3	49·6	151	126·6	82·2	211	177·0	114·9	271	227·3	147·6
32	26·8	17·4	92	77·2	50·1	152	127·5	82·8	212	177·8	115·5	272	228·1	148·1
33	27·7	18·0	93	78·0	50·7	153	128·3	83·3	213	178·6	116·0	273	229·0	148·7
34	28·5	18·5	94	78·8	51·2	154	129·2	83·9	214	179·5	116·6	274	229·8	149·2
35	29·4	19·1	95	79·7	51·7	155	130·0	84·4	215	180·3	117·1	275	230·6	149·8
36	30·2	19·6	96	80·5	52·3	156	130·8	85·0	216	181·2	117·6	276	231·5	150·3
37	31·0	20·2	97	81·4	52·8	157	131·7	85·5	217	182·0	118·2	277	232·3	150·9
38	31·9	20·7	98	82·2	53·4	158	132·5	86·1	218	182·8	118·7	278	233·2	151·4
39	32·7	21·2	99	83·0	53·9	159	133·3	86·6	219	183·7	119·3	279	234·0	152·0
40	33·5	21·8	100	83·9	54·5	160	134·2	87·1	220	184·5	119·8	280	234·8	152·0
41	34·4	22·3	101	84·7	55·0	161	135·0	87·7	221	185·3	120·4	281	235·7	153·0
42	35·2	22·9	102	85·5	55·6	162	135·9	88·2	222	186·2	120·9	282	236·5	153·6
43	36·1	23·4	103	86·4	56·1	163	136·7	88·8	223	187·0	121·5	283	237·3	154·1
44	36·9	24·0	104	87·2	56·6	164	137·5	89·3	224	187·9	122·0	284	238·2	154·7
45	37·7	24·5	105	88·1	57·2	165	138·4	89·9	225	188·7	122·5	285	239·0	155·2
46	38·6	25·1	106	88·9	57·7	166	139·2	90·4	226	189·5	123·1	286	239·9	155·8
47	39·4	25·6	107	89·7	58·3	167	140·1	91·0	227	190·4	123·6	287	240·7	156·3
48	40·3	26·1	108	90·6	58·8	168	140·9	91·5	228	191·2	124·2	288	241·5	156·9
49	41·1	26·7	109	91·4	59·4	169	141·7	92·0	229	192·1	124·7	289	242·4	157·4
50	41·9	27·2	110	92·3	59·9	170	142·6	92·6	230	192·9	125·3	290	243·2	157.9
51	42·8	27·8	111	93·1	60·5	171	143·4	93·1	231	193·7	125·8	291	244·1	158·5
52	43·6	28·3	112	93·9	61·0	172	144·3	93·7	232	194·6	126·4	292	244·9	159·0
53	44·4	28·9	113	94·8	61·5	173	145·1	94·2	233	195·4	126·9	293	245·7	159·6
54	45·3	29·4	114	95·6	62·1	174	145·9	94·8	234	196·2	127·4	294	246·6	160·1
55	46·1	30·0	115	96·4	62·6	175	146·8	95·3	235	197·1	128·0	295	247·4	160·7
56	47·0	30·5	116	97·3	63·2	176	147·6	95·9	236	197·9	128·5	296	248·2	161·2
57	47·8	31·0	117	98·1	63·7	177	148·4	96·4	237	198·8	129·1	297	249·1	161·8
58	48·6	31·6	118	99·0	64·3	178	149·3	96·9	238	199·6	129·6	298	249·9	162·3
59	49·5	32·1	119	99·8	64·8	179	150·1	97·5	239	200·4	130·2	299	250·8	162·8
60	50·3	32·7	120	100·6	65·4	180	151·0	98·0	240	201·3	130·7	300	251·6	163·4
Dist	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

57°=3 h. 48 m.

TABLE 2.

Traverse Table to 34 Degrees = 2h. 16m.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	0·8	0·6	61	50·6	34·1	121	100·3	67·7	181	150·1	101·2	241	199·8	134·8
2	1·7	1·1	62	51·4	34·7	122	101·1	68·2	182	150·9	101·8	242	200·6	135·3
3	2·5	1·7	63	52·2	35·2	123	102·0	68·8	183	151·7	102·3	243	201·5	135·9
4	3·3	2·2	64	53·1	35·8	124	102·8	69·3	184	152·5	102·9	244	202·3	136·4
5	4·1	2·8	65	53·9	36·3	125	103·6	69·9	185	153·4	103·5	245	203·1	137·0
6	5·0	3·4	66	54·7	36·9	126	104·5	70·5	186	154·2	104·0	246	203·9	137·6
7	5·8	3·9	67	55·5	37·5	127	105·3	71·0	187	155·0	104·6	247	204·8	138·1
8	6·6	4·5	68	56·4	38·0	128	106·1	71·6	188	155·9	105·1	248	205·6	138·7
9	7·5	5·0	69	57·2	38·6	129	106·9	72·1	189	156·7	105·7	249	206·4	139·2
10	8·3	5·6	70	58·0	39·1	130	107·8	72·7	190	157·5	106·2	250	207·3	139·8
11	9·1	6·2	71	58·9	39·7	131	108·6	73·3	191	158·3	106·8	251	208·1	140·4
12	9·9	6·7	72	59·7	40·3	132	109·4	73·8	192	159·2	107·4	252	208·9	140·9
13	10·8	7·3	73	60·5	40·8	133	110·3	74·4	193	160·0	107·9	253	209·7	141·5
14	11·6	7·8	74	61·3	41·4	134	111·1	74·9	194	160·8	108·5	254	210·6	142·0
15	12·4	8·4	75	62·2	41·9	135	111·9	75·5	195	161·7	109·0	255	211·4	142·6
16	13·3	8·9	76	63·0	42·5	136	112·7	76·1	196	162·5	109·6	256	212·2	143·2
17	14·1	9·5	77	63·8	43·1	137	113·6	76·6	197	163·3	110·2	257	213·1	143·7
18	14·9	10·1	78	64·7	43·6	138	114·4	77·2	198	164·1	110·7	258	213·9	144·3
19	15·8	10·6	79	65·5	44·2	139	115·2	77·7	199	165·0	111·3	259	214·7	144·8
20	16·6	11·2	80	66·3	44·7	140	116·1	78·3	200	165·8	111·8	260	215·5	145·4
21	17·4	11·7	81	67·2	45·3	141	116·9	78·8	201	166·6	112·4	261	216·4	145·9
22	18·2	12·3	82	68·0	45·9	142	117·7	79·4	202	167·5	113·0	262	217·2	146·5
23	19·1	12·9	83	68·8	46·4	143	118·6	80·0	203	168·3	113·5	263	218·0	147·1
24	19·9	13·4	84	69·6	47·0	144	119·4	80·5	204	169·1	114·1	264	218·9	147·6
25	20·7	14·0	85	70·5	47·5	145	120·2	81·1	205	170·0	114·6	265	219·7	148·2
26	21·6	14·5	86	71·3	48·1	146	121·0	81·6	206	170·8	115·2	266	220·5	148·7
27	22·4	15·1	87	72·1	48·6	147	121·9	82·2	207	171·6	115·8	267	221·4	149·3
28	23·2	15·7	88	73·0	49·2	148	122·7	82·8	208	172·4	116·3	268	222·2	149·9
29	24·0	16·2	89	73·8	49·8	149	123·5	83·3	209	173·3	116·9	269	223·0	150·4
30	24·9	16·8	90	74·6	50·3	150	124·4	83·9	210	174·1	117·4	270	223·8	151·0
31	25·7	17·3	91	75·4	50·9	151	125·2	84·4	211	174·9	118·0	271	224·7	151·5
32	26·5	17·9	92	76·3	51·4	152	126·0	85·0	212	175·8	118·5	272	225·5	152·1
33	27·4	18·5	93	77·1	52·0	153	126·8	85·6	213	176·6	119·1	273	226·3	152·7
34	28·2	19·0	94	77·9	52·6	154	127·7	86·1	214	177·4	119·7	274	227·2	153·2
35	29·0	19·6	95	78·8	53·1	155	128·5	86·7	215	178·2	120·2	275	228·0	153·8
36	29·8	20·1	96	79·6	53·7	156	129·3	87·2	216	179·1	120·8	276	228·8	154·3
37	30·7	20·7	97	80·4	54·2	157	130·2	87·8	217	179·9	121·3	277	229·6	154·9
38	31·5	21·2	98	81·2	54·8	158	131·0	88·4	218	180·7	121·9	278	230·5	155·5
39	32·3	21·8	99	82·1	55·4	159	131·8	88·9	219	181·6	122·5	279	231·3	156·0
40	33·2	22·4	100	82·9	55·9	160	132·6	89·5	220	182·4	123·0	280	232·1	156·6
41	34·0	22·9	101	83·7	56·5	161	133·5	90·0	221	183·2	123·6	281	233·0	157·1
42	34·8	23·5	102	84·6	57·0	162	134·3	90·6	222	184·0	124·1	282	233·8	157·7
43	35·6	24·0	103	85·4	57·6	163	135·1	91·1	223	184·9	124·7	283	234·6	158·3
44	36·5	24·6	104	86·2	58·2	164	136·0	91·7	224	185·7	125·3	284	235·4	158·8
45	37·3	25·2	105	87·0	58·7	165	136·8	92·3	225	186·5	125·8	285	236·3	159·4
46	38·1	25·7	106	87·9	59·3	166	137·6	92·8	226	187·4	126·4	286	237·1	159·9
47	39·0	26·3	107	88·7	59·8	167	138·4	93·4	227	188·2	126·9	287	237·9	160·5
48	39·8	26·8	108	89·5	60·4	168	139·3	93·9	228	189·0	127·5	288	238·8	161·0
49	40·6	27·4	109	90·4	61·0	169	140·1	94·5	229	189·8	128·1	289	239·6	161·6
50	41·5	28·0	110	91·2	61·5	170	140·9	95·1	230	190·7	128·6	290	240·4	162·2
51	42·3	28·5	111	92·0	62·1	171	141·8	95·6	231	191·5	129·2	291	241·2	162·7
52	43·1	29·1	112	92·9	62·6	172	142·6	96·2	232	192·3	129·7	292	242·1	163·3
53	43·9	29·6	113	93·7	63·2	173	143·4	96·7	233	193·2	130·3	293	242·9	163·8
54	44·8	30·2	114	94·5	63·7	174	144·3	97·3	234	194·0	130·9	294	243·7	164·4
55	45·6	30·8	115	95·3	64·3	175	145·1	97·9	235	194·8	131·4	295	244·6	165·0
56	46·4	31·3	116	96·2	64·9	176	145·9	98·4	236	195·7	132·0	296	245·4	165·5
57	47·3	31·9	117	97·0	65·4	177	146·7	99·0	237	196·5	132·5	297	246·2	166·1
58	48·1	32·4	118	97·8	66·0	178	147·6	99·5	238	197·3	133·1	298	247·1	166·6
59	48·9	33·0	119	98·7	66·5	179	148·4	100·1	239	198·1	133·6	299	247·9	167·2
60	49·7	33·6	120	99·5	67·1	180	149·2	100·7	240	199·0	134·2	300	248·7	167·8
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

56° = 3h. 44m.

TABLE 2.

Traverse Table to 35 Degrees = 2h. 20m.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	0·8	0·6	61	50·0	35·0	121	99·1	69·4	181	148·3	103·8	241	197·4	138·2
2	1·6	1·1	62	50·8	35·6	122	99·9	70·0	182	149·1	104·4	242	198·2	138·8
3	2·5	1·7	63	51·6	36·1	123	100·8	70·5	183	149·9	105·0	243	199·1	139·4
4	3·3	2·3	64	52·4	36·7	124	101·6	71·1	184	150·7	105.5	244	199·9	140·0
5	4·1	2·9	65	53·2	37·3	125	102·4	71·7	185	151·5	106·1	245	200·7	140·5
6	4·9	3·4	66	54·1	37·9	126	103·2	72·3	186	152·4	106·7	246	201·5	141·1
7	5·7	4.0	67	54·9	38·4	127	104·6	72·8	187	153·2	107·3	247	202·3	141·7
8	6·6	4·6	68	55·7	39·0	128	104·9	73·4	188	154·0	107·8	248	203·1	142·2
9	7·4	5·2	69	56·5	39·6	129	105·7	74·0	189	154·8	108·4	249	204·0	142·8
10	8·2	5·7	70	57·3	40·2	130	106·6	74·6	190	155·6	109·0	250	204·8	143·4
11	9·0	6·3	71	58·2	40·7	131	107·3	75·1	191	156·5	109·6	251	205·6	144·0
12	9·8	6·9	72	59·0	41·3	132	108·1	75·7	192	157·3	110.1	252	206·4	144·5
13	10·6	7·5	73	59·8	41·9	133	108·9	76·3	193	158·1	110·7	253	207·2	145·1
14	11·5	8·0	74	60·6	42·4	134	109·8	76·9	194	158·9	111·3	254	208·1	145·7
15	12·3	8·6	75	61·4	43·0	135	110·6	77·4	195	159·7	111·8	255	208·9	146·3
16	13·1	9·2	76	62·3	43·6	136	111·4	78·0	196	160·6	112·4	256	209·7	146·8
17	13·9	9·8	77	63·1	44·2	137	112·2	78·6	197	161·4	113·0	257	210·5	147·4
18	14·7	10·3	78	63·9	44·7	138	113·0	79·2	198	162·2	113·6	258	211·3	148·0
19	15·6	10·9	79	64·7	45·3	139	113·9	79·7	199	163·0	114·1	259	212·2	148·6
20	16·4	11·5	80	65·5	45·9	140	114·7	80·3	200	163·8	114·7	260	213·0	149·1
21	17·2	12·0	81	66·4	46·5	141	115·5	80·9	201	164·6	115·3	261	213·8	149·7
22	18·0	12·6	82	67·2	47·0	142	116·3	81·4	202	165·5	115·9	26[illegible]	[illegible]·6	150·3
23	18·8	13·2	83	68·0	47·6	143	117·1	82·0	203	166·3	116·4	263	[illegible]5·4	150·9
24	19·7	13·8	84	68·8	48·2	144	118·0	82·6	204	167·1	117·0	264	[illegible]16·3	151·4
25	20·5	14·3	85	69·6	48·8	145	118·8	83·2	205	167·9	117·6	265	217·1	152·0
26	21·3	14·9	86	70·4	49·3	146	119·6	83·7	206	168·7	118·2	266	217·9	152·6
27	22·1	15·5	87	71·3	49·9	147	120·4	84·3	207	169·6	118·7	267	218·7	153·1
28	22·9	16·1	88	72·1	50·5	148	121·2	84·9	208	170·4	119·3	268	219·5	153·7
29	23·8	16·6	89	72·9	51·0	149	122·1	85·5	209	171·2	119·9	269	220·4	154·3
30	24·6	17·2	90	73·7	51·6	150	122·9	86·0	210	172·0	120·5	270	221·2	154·9
31	25·4	17·8	91	74·5	52·2	151	123·7	86·6	211	172·8	121·0	271	222·0	155·4
32	26·2	18·4	92	75·4	52·8	152	124·5	87·2	212	173·7	121·6	272	222·8	156·0
33	27·0	18·9	93	76·2	53·3	153	125·3	87·8	213	174·5	122·2	273	223·6	156·6
34	27·9	19·5	94	77·0	53·9	154	126·1	88·3	214	175·3	122·7	274	224·4	157·2
35	28·7	20·1	95	77·8	54·5	155	127·0	88·9	215	176·1	123·3	275	225·3	157·7
36	29·5	20·6	96	78·6	55·1	156	127·8	89·5	216	176·9	123·9	276	226·1	158·3
37	30·3	21·2	97	79·5	55·6	157	128·6	90·1	217	177·8	124·5	277	226·9	158·9
38	31.1	21·8	98	80·3	56·2	158	129·4	90·6	218	178·6	125·0	278	227·7	159·5
39	31·9	22·4	99	81·1	56·8	159	130·2	91·2	219	179·4	125·6	279	228·5	160·0
40	32.8	22·9	100	81·9	57·4	160	131·1	91·8	220	180·2	126·2	280	229·4	160·6
41	33·6	23·5	101	82·7	57·9	161	131·9	92·3	221	181·0	126·8	281	230·3	161·2
42	34·4	24·1	102	83·6	58·5	162	132·7	92·9	222	181·9	127·3	282	231·0	161·7
43	35·2	24·7	103	84·4	59·1	163	133·5	93·5	223	182·7	127·9	283	231·8	162·3
44	36·0	25·2	104	85·2	59·7	164	134·3	94·1	224	183·5	128·5	284	232·6	162·9
45	36·9	25·8	105	86·0	60·2	165	135·2	94·6	225	184·3	129·1	285	233·5	163·5
46	37·7	26·4	106	86·8	60·8	166	136·0	95·2	226	185·1	129·6	286	234·3	164·0
47	38·5	27·0	107	87·6	61·4	167	136·8	95·8	227	185·9	130·2	287	235·1	164·6
48	39·3	27·5	108	88·5	61·9	168	137·7	96·4	228	186·8	130·8	288	235·9	165·2
49	40·1	28·1	109	89·3	62·5	169	138·4	96·9	229	187·6	131·3	289	236·7	165·8
50	41·0	28·7	110	90·1	63·1	170	139·3	97·5	230	188·4	131·9	290	237·6	166·3
51	41·8	29·3	111	90·9	63·7	171	140·1	98·1	231	189·2	132·5	291	238·4	166·9
52	42·6	29·8	112	91·7	64·2	172	140·9	98·7	232	190·0	133·1	292	239·2	167·5
53	43·4	30·4	113	92·6	64·8	173	141·7	99·2	233	190·9	133·6	293	240·0	168·9
54	44·2	31·0	114	93·4	65·4	174	142·5	99·8	234	191·7	134·2	294	240·8	168·6
55	45·1	31·5	115	94·2	66·0	175	143·4	100·4	235	192·5	134·8	295	241·6	169·2
56	45·9	32·1	116	95·0	66·5	176	144·2	100·9	236	193·3	135·4	296	242·5	169·8
57	46·7	32·7	117	95·8	67·1	177	145·0	101·5	237	194·1	135·9	297	243·3	170·4
58	47·5	33·3	118	96·7	67·7	178	145·8	102·1	238	195·0	136·5	298	244·1	170·9
59	48·3	33·8	119	97·5	68·3	179	146·6	102·7	239	195·8	137·1	299	244·9	171·5
60	49·1	34·4	120	98·3	68·8	180	147·4	103·2	240	196·6	137·7	300	245·7	172·1
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

55° = 3h. 40m.

TABLE 2.

Traverse Table to 36 Degrees=2h 24m.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	0·8	0·6	61	49·4	35·9	121	97·9	71·1	181	146·4	106·4	241	195·0	141·7
2	1·6	1·2	62	50·2	36·4	122	98·7	71·7	182	147·2	107·0	242	195·8	142·2
3	2·4	1·8	63	51·0	37·0	123	99·5	72·3	183	148·1	107·6	243	196·6	142·8
4	3·2	2·4	64	51·8	37·6	124	100·3	72·9	184	148·9	108·2	244	197·4	143·4
5	4·0	2·9	65	52·6	38·2	125	101·1	73·5	185	149·7	108·7	245	198·2	144·0
6	4·9	3·5	66	53·4	38·8	126	101·9	74·1	186	150·5	109·3	246	199·0	144·6
7	5·7	4·1	67	54·2	39·4	127	102·7	74·6	187	151·3	109·9	247	199·8	145·2
8	6·5	4·7	68	55·0	40·0	128	103·6	75·2	188	152·1	110·5	248	200·6	145·8
9	7·3	5·3	69	55·8	40·6	129	104·4	75·8	189	152·9	111·1	249	201·4	146·4
10	8·1	5·9	70	56·6	41·1	130	105·2	76·4	190	153·7	111·7	250	202·3	146·9
11	8·9	6·5	71	57·4	41·7	131	106·0	77·0	191	154·5	112·3	251	203·1	147·5
12	9·7	7·1	72	58·2	42·3	132	106·8	77·6	192	155·3	112·9	252	203·9	148·1
13	10·5	7·6	73	59·1	42·9	133	107·6	78·2	193	156·1	113·4	253	204·7	148·7
14	11·3	8·2	74	59·9	43·5	134	108·4	78·8	194	156·9	114·0	254	205·5	149·3
15	12·1	8·8	75	60·7	44·1	135	109·2	79·4	195	157·8	114·6	255	206·3	149·9
16	12·9	9·4	76	61·5	44·7	136	110·0	79·9	196	158·6	115·2	256	207·1	150·5
17	13·8	10·0	77	62·3	45·3	137	110·8	80·5	197	159·4	115·8	257	207·9	151·1
18	14·6	10·6	78	63·1	45·8	138	111·6	81·1	198	160·2	116·4	258	208·7	151·6
19	15·4	11·2	79	63·9	46·4	139	112·5	81·7	199	161·0	117·0	259	209·5	152·2
20	16·2	11·8	80	64·7	47·0	140	113·3	82·3	200	161·8	117·6	260	210·3	152·8
21	17·0	12·3	81	65·5	47·6	141	114·1	82·9	201	162·6	118·1	261	211·1	153·4
22	17·8	12·9	82	66·3	48·2	142	114·9	83·5	202	163·4	118·7	262	212·0	154·0
23	18·6	13·5	83	67·1	48·8	143	115·7	84·1	203	164·2	119·3	263	212·8	154·6
24	19·4	14·1	84	68·0	49·4	144	116·5	84·6	204	165·0	119·9	264	213·6	155·2
25	20·2	14·7	85	68·8	50·0	145	117·3	85·2	205	165·8	120·5	265	214·4	155·8
26	21·0	15·3	86	69·6	50·5	146	118·1	85·8	206	166·7	121·1	266	215·2	156·4
27	21·8	15·9	87	70·4	51·1	147	118·9	86·4	207	167·5	121·7	267	216·0	156·9
28	22·7	16·5	88	71·2	51·7	148	119·7	87·0	208	168·3	122·3	268	216·8	157·5
29	23·5	17·0	89	72·0	52·3	149	120·5	87·6	209	169·1	122·8	269	217·6	158·1
30	24·3	17·6	90	72·8	52·9	150	121·4	88·2	210	169·9	123·4	270	218·4	158·7
31	25·1	18·2	91	73·6	53·5	151	122·2	88·8	211	170·7	124·0	271	219·2	159·3
32	25·9	18·8	92	74·4	54·1	152	123·0	89·3	212	171·5	124·6	272	220·1	159·9
33	26·7	19·4	93	75·2	54·7	153	123·8	89·9	213	172·3	125·2	273	220·9	160·5
34	27·5	20·0	94	76·0	55·3	154	124·6	90·5	214	173·1	125·8	274	221·7	161·1
35	28·3	20·6	95	76·9	55·8	155	125·4	91·1	215	173·9	126·4	275	222·5	161·6
36	29·1	21·2	96	77·7	56·4	156	126·2	91·7	216	174·7	127·0	276	223·3	162·2
37	29·9	21·7	97	78·5	57·0	157	127·0	92·3	217	175·6	127·5	277	224·1	162·8
38	30·7	22·3	98	79·3	57·6	158	127·8	92·9	218	176·4	128·1	278	224·9	163·4
39	31·6	22·9	99	80·1	58·2	159	128·6	93·5	219	177·2	128·7	279	225·7	164·0
40	32·4	23·5	100	80·9	58·8	160	129·4	94·0	220	178·0	129·3	280	226·5	164·6
41	33·2	24·1	101	81·7	59·4	161	130·3	94·6	221	178·8	129·9	281	227·3	165·2
42	34·0	24·7	102	82·5	60·0	162	131·1	95·2	222	179·6	130·5	282	228·1	165·8
43	34·8	25·3	103	83·3	60·5	163	131·9	95·8	223	180·4	131·1	283	229·0	166·3
44	35·6	25·9	104	84·1	61·1	164	132·7	96·4	224	181·2	131·7	284	229·8	166·9
45	36·4	26·5	105	84·9	61·7	165	133·5	97·0	225	182·0	132·3	285	230·6	167·4
46	37·2	27·0	106	85·8	62·3	166	134·3	97·6	226	182·8	132·8	286	231·4	168·1
47	38·0	27·6	107	86·6	62·9	167	135·1	98·2	227	183·6	133·4	287	232·2	168·7
48	38·8	28·2	108	87·4	63·5	168	135·9	98·7	228	184·5	134·0	288	233·0	169·3
49	39·6	28·8	109	88·2	64·1	169	136·7	99·3	229	185·3	134·6	289	233·8	169·9
50	40·5	29·4	110	89·0	64·7	170	137·5	99·9	230	186·1	135·2	290	234·6	170·5
51	41·3	30·0	111	89·8	65·2	171	138·3	100·5	231	186·9	135·8	291	235·4	171·0
52	42·1	30·6	112	90·6	65·8	172	139·2	101·1	232	187·7	136·4	292	236·2	171·6
53	42·9	31·2	113	91·4	66·4	173	140·0	101·7	233	188·5	137·0	293	237·0	172·2
54	43·7	31·7	114	92·2	67·0	174	140·8	102·3	234	189·3	137·5	294	237·9	172·8
55	44·5	32·3	115	93·0	67·6	175	141·6	102·9	235	190·1	138·1	295	238·7	173·4
56	45·3	32·9	116	93·8	68·2	176	142·4	103·5	236	190·9	138·7	296	239·5	174·0
57	46·1	33·5	117	94·7	68·8	177	143·2	104·0	237	191·7	139·3	297	240·3	174·6
58	46·9	34·1	118	95·5	69·4	178	144·0	104·6	238	192·5	139·9	298	241·1	175·2
59	47·7	34·7	119	96·3	69·9	179	144·8	105·2	239	193·4	140·6	299	241·9	175·7
60	48·5	35·3	120	97·1	70·5	180	145·6	105·8	240	194·2	141·1	300	242·7	176·3
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

54°=3h. 36m.

TABLE 2.

Traverse Table to 37 Degrees=2h. 28m.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	0·8	0·6	61	48·7	36·7	121	96·6	72·8	181	144·6	108·9	241	192·5	145·0
2	1·6	1·2	62	49·5	37·3	122	97·4	73·4	182	145·4	109·5	242	193·3	145·6
3	2·4	1·8	63	50·3	37·9	123	98·2	74·0	183	146·2	110·1	243	194·1	146·2
4	3·2	2·4	64	51·1	38·5	124	99·0	74·6	184	146·9	110·7	244	194·9	146·8
5	4·0	3·0	65	51·9	39·1	125	99·8	75·2	185	147·7	111·3	245	195·7	147·4
6	4·8	3·6	66	52·7	39·7	126	100·6	75·8	186	148·5	111·9	246	196·5	148·0
7	5·6	4·2	67	53·5	40·3	127	101·4	76·4	187	149·3	112·5	247	197·3	148·6
8	6·4	4·8	68	54·3	40·9	128	102·2	77·0	188	150·1	113·1	248	198·1	149·3
9	7·2	5·4	69	55·1	41·5	129	103·0	77·6	189	150·9	113·7	249	198·9	149·9
10	8·0	6·0	70	55·9	42·1	130	103·8	78·2	190	151·7	114·3	250	199·7	150·5
11	8·8	6·6	71	56·7	42·7	131	104·6	78·8	191	152·5	114·9	251	200·5	151·1
12	9·6	7·2	72	57·5	43·3	132	105·4	79·4	192	153·3	115·5	252	201·3	151·7
13	10·4	7·8	73	58·3	43·9	133	106·2	80·0	193	154·1	116·2	253	202·1	152·3
14	11·2	8·4	74	59·1	44·5	134	107·0	80·6	194	154·9	116·8	254	202·9	152·9
15	12·0	9·0	75	59·9	45·1	135	107·8	81·2	195	155·7	117·4	255	203·7	153·5
16	12·8	9·6	76	60·7	45·7	136	108·6	81·8	196	156·5	118·0	256	204·5	154·1
17	13·6	10·2	77	61·5	46·3	137	109·4	82·4	197	157·3	118·6	257	205·2	154·7
18	14·4	10·8	78	62·3	46·9	138	110·2	83·1	198	158·1	119·2	258	206·0	155·3
19	15·2	11·4	79	63·1	47·5	139	111·0	83·7	199	158·9	119·8	259	206·8	155·9
20	16·0	12·0	80	63·9	48·1	140	111·8	84·3	200	159·7	120·4	260	207·6	156·5
21	16·8	12.6	81	64·7	48·7	141	112·6	84·9	201	160·5	121·0	261	208·4	157·1
22	17·6	13·2	82	65·5	49·3	142	113·4	85·5	202	161·3	121·6	262	209·2	157·7
23	18·4	13·8	83	66·3	50·0	143	114·2	86·1	203	162·1	122·2	263	210·0	158·3
24	19·2	14·4	84	67·1	50·6	144	115·0	86·7	204	162·9	122·8	264	210·8	158·9
25	20·0	15·0	85	67·9	51·2	145	115·8	87·3	205	163·7	123·4	265	211·6	159·5
26	20·8	15·6	86	68·7	51·8	146	116·6	87·9	206	164·5	124·0	266	212·4	160·1
27	21·6	16·2	87	69·5	52·4	147	117·4	88·5	207	165·3	124·6	267	213·2	160·7
28	22·4	16·9	88	70·3	53·0	148	118·2	89·1	208	166·1	125·2	268	214·0	161·3
29	23·2	17·5	89	71·1	53·6	149	119·0	89·7	209	166·9	125·8	269	214·8	161·9
30	24·0	18·1	90	71·9	54·2	150	119·8	90·3	210	167·7	126·4	270	215·6	162·5
31	24·8	18·7	91	72·7	54·8	151	120·6	90·9	211	168·5	127·0	271	216·4	163·1
32	25·6	19·3	92	73·5	55·4	152	121·4	91·5	212	169·3	127·6	272	217·2	163·7
33	26·4	19·9	93	74·3	56·0	153	122·2	92·1	213	170·1	128·2	273	218·0	164·3
34	27·2	20·5	94	75·1	56·6	154	123·0	92·7	214	170·9	128·8	274	218·8	164·9
35	28·0	21·1	95	75·9	57·2	155	123·8	93·3	215	171·7	129·4	275	219·6	165·5
36	28·8	21·7	96	76·7	57·8	156	124·6	93·9	216	172·5	130·0	276	220·4	166·1
37	29·5	22·3	97	77·5	58·4	157	125·4	94·5	217	173·3	130·6	277	221·2	166·7
38	30·3	22·9	98	78·3	59·0	158	126·2	95·1	218	174·1	131·2	278	222·0	167·3
39	31·1	23·5	99	79·1	59·6	159	127·0	95·7	219	174·9	131·8	279	222·8	167·9
40	31·9	24·1	100	79·9	60·2	160	127·8	96·3	220	175·7	132·4	280	223·6	168·5
41	32·7	24·7	101	80·7	60·8	161	128·6	96·9	221	176·5	133·0	281	224·4	169·1
42	33·5	25·3	102	81·5	61·4	162	129·4	97·5	222	177·3	133·6	282	225·2	169·7
43	34·3	25·9	103	82·3	62·0	163	130·2	98·1	223	178·1	134·2	283	226·0	170·3
44	35·1	26·5	104	83·1	62·6	164	131·0	98·7	224	178·9	134·8	284	226·8	170·9
45	35·9	27·1	105	83·9	63·2	165	131·8	99·3	225	179·7	135·4	285	227·6	171·5
46	36·7	27·7	106	84·7	63·8	166	132·6	99·9	226	180·5	136·0	286	228·4	172·1
47	37·5	28 3	107	85·5	64·4	167	133·4	100·5	227	181·3	136·6	287	229·2	172·7
48	38·3	28·9	108	86·3	65·0	168	134·2	101·1	228	182·1	137·2	288	230·0	173·3
49	39·1	29·5	109	87·1	65·6	169	135·0	101·7	229	182·9	137·8	289	230·8	173·9
50	39·9	30·1	110	87·8	66·2	170	135·8	102·3	230	183·7	138·4	290	231·6	174·5
51	40·7	30·7	111	88·6	66·8	171	136·6	102·9	231	184·5	139·0	291	232·4	175·1
52	41·5	31·3	112	89·4	67·4	172	137·4	103·5	232	185·3	139·6	292	233·2	175·7
53	42·3	31·9	113	90·2	68·0	173	138·2	104·1	233	186·1	140·2	293	234·0	176·3
54	43·1	32·5	114	91·0	68·6	174	139·0	104·7	234	186·9	140·8	294	234·8	176·9
55	43·9	33·1	115	91·8	69·2	175	139·8	105·3	235	187·7	141·4	295	235·6	177·5
56	44·7	33·7	116	92·6	69·8	176	140·6	105·9	236	188·5	142·0	296	236·4	178·1
57	45·5	34·3	117	93·4	70·4	177	141·4	106·5	237	189·3	142·6	297	237·2	178·7
58	46·3	34·9	118	94·2	71·0	178	142·2	107·1	238	190·1	143·2	298	238·0	179·3
59	47·1	35·5	119	95·0	71·6	179	143·0	107·8	239	190·9	143·8	299	238·8	179·9
60	47·9	36·1	120	95·8	72·2	180	143·8	108·3	240	191·7	144·4	300	239·6	180·5
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

53°=3h. 32m.

TABLE 2.

Traverse Table to 38 Degrees = 2h. 32m.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	0·8	0·6	61	48·1	37·6	121	95·3	74·5	181	142·6	111·4	241	189·9	148·4
2	1·6	1·2	62	48·9	38·2	122	96·1	75·1	182	143·4	112·1	242	190·7	149·0
3	2·4	1·8	63	49·6	38·8	123	96·9	75·5	183	144·2	112·7	243	191·5	149·6
4	3·2	2·5	64	50·4	39·4	124	97·7	76·3	184	145·0	113·3	244	192·3	150·2
5	3·9	3·1	65	51·2	40·0	125	98·5	77·0	185	145·8	113·9	245	193·1	150·8
6	4·7	3·7	66	52·0	40·6	126	99·3	77·6	186	146·6	114·5	246	193·9	151·5
7	5·5	4·3	67	52·8	41·2	127	100·1	78·2	187	147·4	115·1	247	194·6	152·1
8	6·3	4·9	68	53·6	41·9	128	100·9	78·8	188	148·1	115·7	248	195·4	152·7
9	7·1	5·5	69	54·4	42·5	129	101·7	79·4	189	148·9	116·4	249	196·2	153·3
10	7·9	6·2	70	55·2	43·1	130	102·4	80·0	190	149·7	117·0	250	197·0	153·9
11	8·7	6·8	71	55·9	43·7	131	103·2	80·7	191	150·5	117·6	251	197·8	154·5
12	9·5	7·4	72	56·7	44·3	132	104·0	81·8	192	151·3	118·2	252	198·6	155·1
13	10·2	8·0	73	57·5	44·9	133	104·8	81·9	193	152·1	118·8	253	199·4	155·8
14	11·0	8·6	74	58·3	45·6	134	105·6	82·5	194	152·9	119·4	254	200·2	156·4
15	11·8	9·2	75	59·1	46·2	135	106·4	83·1	195	153·7	120·1	255	200·9	157·0
16	12·6	9·9	76	59·9	46·8	136	107·2	83·7	196	154·5	120·7	256	201·7	157·6
17	13·4	10·5	77	60·7	47·4	137	108·0	84·3	197	155·2	121·3	257	202·5	158·2
18	14·2	11·1	78	61·5	48·0	138	108·7	85·0	198	156·0	121·9	258	203·3	158·8
19	15·0	11·7	79	62·3	48·6	139	109·5	85·6	199	156·8	122·5	259	204·1	159·5
20	15·8	12·3	80	63·0	49·3	140	110·2	86·2	200	157·6	123·1	260	204·9	160·1
21	16·5	12·9	81	63·8	49·9	141	111·1	86·8	201	158·4	123·7	261	205·7	160·7
22	17·3	13·5	82	64·6	50·5	142	111·9	87·4	202	159·2	124·4	262	206·5	161·3
23	18·1	14·2	83	65·4	51·1	143	112·7	88·0	203	160·0	125·0	263	207·2	161·9
24	18·9	14·8	84	66·2	51·7	144	113·5	88·7	204	160·8	125·6	264	208·0	162·5
25	19·7	15·4	85	67·0	52·3	145	114·3	89·3	205	161·5	126·2	265	208·8	163·2
26	20·5	16·0	86	67·8	52·9	146	115·0	89·9	206	162·3	126·8	266	209·6	163·8
27	21·3	16·6	87	68·6	53·6	147	115·8	90·5	207	163·1	127·4	267	210·4	164·4
28	22·1	17·2	88	69·3	54·2	148	116·6	91·1	208	163·9	128·1	268	211·2	165·0
29	22·9	17·9	89	70·1	54·8	149	117·4	91·7	209	164·7	128·7	269	212·0	165·6
30	23·6	18·5	90	70·9	55·4	150	118·2	92·3	210	165·5	129·3	270	212·8	166·2
31	24·4	19·1	91	71·7	56·0	151	119·0	93·0	211	166·3	129·9	271	213·6	166·8
32	25·2	19·7	92	72·5	56·6	152	119·8	93·6	212	167·1	130·5	272	214·3	167·5
33	26·0	20·3	93	73·3	57·3	153	120·6	94·2	213	167·8	131·1	273	215·1	168·1
34	26·8	20·9	94	74·1	57·9	154	121·4	94·8	214	168·6	131·8	274	215·9	168·7
35	27·6	21·5	95	74·9	58·5	155	122·1	95·4	215	169·4	132·4	275	216·7	169·3
36	28·4	22·2	96	75·6	59·1	156	122·9	96·0	216	170·2	133·0	276	217·5	169·9
37	29·2	22·8	97	76·4	59·7	157	123·7	96·7	217	171·0	133·6	277	218·3	170·5
38	29·9	23·4	98	77·2	60·3	158	124·5	97·3	218	171·8	134·2	278	219·1	171·2
39	30·7	24·0	99	78·0	61·0	159	125.3	97·9	219	172·6	134·8	279	219·9	171·8
40	31·5	24·6	100	78·8	61·6	160	126·1	98·5	220	173·4	135·4	280	220·6	172·4
41	32·3	25·2	101	79·6	62·2	161	126·9	99·1	221	174·2	136·1	281	221·4	173·0
42	33·1	25·9	102	80·4	62·8	162	127·7	99·7	222	174·9	136·7	282	222·2	173·6
43	33·9	26·5	103	81·2	63·4	163	128·4	100·4	223	175·7	137·3	283	223·0	174·2
44	34·7	27·1	104	82·0	64·0	164	129·2	101·0	224	176·5	137·9	284	223·8	174·8
45	35·5	27·7	105	82·7	64·6	165	130·0	101·6	225	177·3	138·5	285	224·6	175·5
46	36·2	28·3	106	83·5	65·3	166	130·8	102·2	226	178·1	139·1	286	225·4	176·1
47	37·0	28·9	107	84·3	65·9	167	131·6	102·8	227	178·9	139·8	287	226·2	176·7
48	37·8	29·6	108	85·1	66·5	168	132·4	103·4	228	179·7	140·4	288	226·9	177·3
49	38·6	30·2	109	85·9	67·1	169	133·3	104·0	229	180·5	141·0	289	227·7	177·9
50	39·4	30·8	110	86·7	67·7	170	134·0	104·7	230	181·2	141·6	290	228·5	178·5
51	40·2	31·4	111	87·5	68·3	171	134·7	105·3	231	182·0	142·2	291	229·3	179·2
52	41·0	32·0	112	88·3	69·0	172	135·5	105·9	232	182·8	142·8	292	230·1	179·8
53	41·8	32·6	113	89·0	69·6	173	136·3	106·5	233	183·6	143·4	293	230·9	180·4
54	42·6	33·2	114	89·8	70·2	174	137·1	107·1	234	184·4	144·1	294	231·7	181·0
55	43.3	33·9	115	90·6	70·8	175	137·9	107·7	235	185·2	144·7	295	232·5	181·6
56	44·1	34·5	116	91·4	71·4	176	138·7	108·4	236	186·0	145·3	296	233·3	182·2
57	44·9	35·1	117	92·2	72·0	177	139·5	109·0	237	186·8	145·9	297	234·0	182·9
58	45·7	35·7	118	93·0	72·6	178	140·3	109·6	238	187·5	146·5	298	234·8	183·5
59	46·5	36·3	119	93·8	73·3	179	141·1	110·2	239	188·3	147·1	299	235·6	184·1
60	47·3	36·9	120	94·6	73·9	180	141·8	110·8	240	189·1	147·8	300	236·4	184·7
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

52° = 3h. 28m.

TABLE 2.

Traverse Table to 39 Degrees = 2h. 36m.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	0·8	0·6	61	47·4	38·4	121	94·0	76·1	181	140·7	113·9	241	187·3	151·7
2	1·6	1·3	62	48·2	39·0	122	94·8	76·8	182	141·4	114·5	242	188·1	152·3
3	2·3	1·9	63	49·0	39·6	123	95·6	77·4	183	142·2	115·2	243	188·8	152·9
4	3·1	2·5	64	49·7	40·3	124	96·4	78·0	184	143·0	115·8	244	189·6	153·6
5	3·9	3·1	65	50·5	40·9	125	97·1	78·7	185	143·8	116·4	245	190·4	154·2
6	4·7	3·8	66	51·3	41·5	126	97·9	79·3	186	144·5	117·1	246	191·2	154·8
7	5·4	4·4	67	52·1	42·2	127	98·7	79·9	187	145·3	117·7	247	192·0	155·4
8	6·2	5·0	68	52·8	42·8	128	99·5	80·6	188	146·1	118·3	248	192·7	156·1
9	7·0	5·7	69	53·6	43·4	129	100·3	81·2	189	146·9	118·9	249	193·5	156·7
10	7·8	6·3	70	54·4	44·1	130	101·0	81·8	190	147·7	119·6	250	194·3	157·3
11	8·5	6·9	71	55·2	44·7	131	101·8	82·4	191	148·4	120·2	251	195·1	158·0
12	9·3	7·6	72	56·0	45·3	132	102·6	83·1	192	149·2	120·8	252	195·8	158·6
13	10·1	8·2	73	56·7	45·9	133	103·4	83·7	193	150·0	121·5	253	196·6	159·2
14	10·9	8·8	74	57·5	46·6	134	104·1	84·3	194	150·8	122·1	254	197·4	159·8
15	11·7	9·4	75	58·3	47·2	135	104·9	85·0	195	151·5	122·7	255	198·2	160·5
16	12·4	10·1	76	59·1	47·8	136	105·7	85·6	196	152·3	123·3	256	198·9	161·1
17	13·2	10·7	77	59·8	48·5	137	106·5	86·2	197	153·1	124·0	257	199·7	161·7
18	14·0	11·3	78	60·6	49·1	138	107·2	86·8	198	153·9	124·6	258	200·5	162·4
19	14·8	12·0	79	61·4	49·7	139	108·0	87·5	199	154·7	125·2	259	201·3	163·0
20	15·5	12·6	80	62·2	50·3	140	108·8	88·1	200	155·4	125·9	260	202·1	163·6
21	16·3	13·2	81	62·9	51·0	141	109·6	88·7	201	156·2	126·5	261	202·8	164·3
22	17·1	13·8	82	63·7	51·6	142	110·4	89·4	202	157·0	127·1	262	203·6	164·9
23	17·9	14·5	83	64·5	52·2	143	111·1	90·0	203	157·8	127·8	263	204·4	165·5
24	18·7	15·1	84	65·3	52.9	144	111·9	90·6	204	158·5	128·4	264	205·2	166·1
25	19·4	15·7	85	66·1	53·5	145	112·7	91·3	205	159·3	129·0	265	205·9	166·8
26	20·2	16·4	86	66·8	54·1	146	113·5	91·9	206	160·1	129·6	266	206·7	167·4
27	21·0	17·0	87	67·6	54·8	147	114·2	92·5	207	160·9	130·3	267	207·5	168·0
28	21·8	17·6	88	68·4	55·4	148	115·0	93·1	208	161·6	130·9	268	208·3	168·7
29	22·5	18·3	89	69·2	56·0	149	115·8	93·8	209	162·4	131·5	269	209·1	169·3
30	23·3	18·9	90	69·9	56·6	150	116·6	94·4	210	163·2	132·2	270	209·8	169·9
31	24·1	19·5	91	70·7	57·3	151	117·3	95·0	211	164·0	132·8	271	210·6	170·5
32	24·9	20·1	92	71·5	57·9	152	118·1	95·7	212	164·8	133·4	272	211·4	171·2
33	25·6	20·8	93	72·3	58·5	153	118·9	96·3	213	165·5	134·0	273	212·2	171·8
34	26·4	21·4	94	73·1	59·2	154	119·7	96·9	214	166·3	134·7	274	212·9	172·4
35	27·2	22·0	95	73·8	59·8	155	120·5	97·5	215	167·1	135·3	275	213·7	173·1
36	28·0	22·7	96	74·6	60·4	156	121·2	98·2	216	167·9	135·9	276	214·5	173·7
37	28·8	23·3	97	75·4	61·0	157	122·0	98·8	217	168·6	136·6	277	215·3	174·3
38	29·5	23·9	98	76·2	61·7	158	122·8	99·4	218	169·4	137·2	278	216·0	175·0
39	30·3	24·5	99	76·9	62·3	159	123·6	100·1	219	170·2	137·8	279	216·8	175·6
40	31·1	25.2	100	77·7	62·9	160	124·3	100·7	220	171·0	138·5	280	217·6	176·2
41	31·9	25·8	101	78·5	63·6	161	125·1	101·3	221	171·7	139·1	281	218·4	176·8
42	32·6	26·4	102	79·3	64·2	162	125·9	101·9	222	172·5	139·7	282	219·2	177·5
43	33·4	27·1	103	80·0	64·8	163	126·7	102·6	223	173·3	140·3	283	219·9	178·1
44	34·2	27·7	104	80·8	65·4	164	127·5	103·2	224	174·1	141·0	284	220·7	178·7
45	35·0	28·3	105	81·6	66·1	165	128·2	103·8	225	174·9	141·6	285	221·5	179·4
46	35·7	28·9	106	82·4	66·7	166	129·0	104·5	226	175·6	142·2	286	222·3	180·0
47	36·5	29·6	107	83·2	67·3	167	129·8	105·1	227	176·4	142·9	287	223·0	180·6
48	37·3	30·2	108	83·9	68·0	168	130·6	105·7	228	177·2	143·5	288	223·8	181·2
49	38·1	30·8	109	84·7	68·6	169	131·3	106·4	229	178·0	144·1	289	224·6	181·9
50	38·9	31·5	110	85·5	69·2	170	132·1	107·0	230	178·7	144·7	290	225·4	182·5
51	39·6	32·1	111	86·3	69·9	171	132·9	107·6	231	179·5	145·4	291	226·1	183·1
52	40·4	32·7	112	87·0	70·5	172	133·7	108·2	232	180·3	146·0	292	226·9	183·8
53	41·2	33·4	113	87·8	71·1	173	134·4	108·9	233	181·1	146·6	293	227·7	184·4
54	42·0	34·0	114	88·6	71·7	174	135·2	109·5	234	181·9	147·3	294	228·5	185·0
55	42·7	34·6	115	89·4	72·4	175	136·0	110·1	235	182·6	147·9	295	229·3	185·6
56	43·5	35·2	116	90·1	73·0	176	136·8	110·8	236	183·4	148·5	296	230·0	186·3
57	44·3	35·9	117	90·9	73·6	177	137·6	111·4	237	184·2	149·1	297	230·8	186·9
58	45·1	36·5	118	91·7	74·3	178	138·3	112·0	238	185·0	149·8	298	231·6	187·5
59	45·9	37·1	119	92·5	74·9	179	139·1	112·6	239	185·7	150·4	299	232·4	188·2
60	46·6	37·8	120	93·3	75·5	180	139·9	113·3	240	186·5	151·0	300	233·1	188·8
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

51° = 8h. 24m.

TABLE 2.

Traverse Table to 40 Degrees = 2 h. 40m.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dis	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	0·8	0·6	61	46·7	39·2	121	92·7	77·8	181	138·7	116·3	241	184·6	154·9
2	1·5	1·3	62	47·5	39·9	122	93·5	78·4	182	139·4	117·0	242	185·4	155·6
3	2·3	1·9	63	48·3	40·5	123	94·2	79·1	183	140·2	117·6	243	186·1	156·2
4	3·1	2·6	64	49·0	41·1	124	95·0	79·7	184	141·0	118·3	244	186·9	156·8
5	3·8	3·2	65	49·8	41·8	125	95·8	80·3	185	141·7	118·9	245	187·7	157·5
6	4·6	3·9	66	50·6	42·4	126	96·5	81·0	186	142·5	119·6	246	188·4	158·1
7	5·4	4·5	67	51·3	43·1	127	97·3	81·6	187	143·3	120. 2	247	189·2	158·8
8	6·1	5·1	68	52·1	43·7	128	98·1	82·3	188	144·0	120·8	248	190·0	159·4
9	6·9	5·8	69	52·9	44·4	129	98·8	82·9	189	144·8	121·5	249	190·7	160·1
10	7·7	6·4	70	53·6	45·0	130	99·6	83·6	190	145·5	122·1	250	191·5	160·7
11	8·4	7·1	71	54·4	45·6	131	100·4	84·2	191	146·3	122·8	251	192·3	161·3
12	9·2	7·7	72	55·2	46·3	132	101·1	84·8	192	147·1	123·4	252	193·0	162·0
13	10·0	8·4	73	55·9	46·9	133	101·9	85·5	193	147·8	124·1	253	193·8	162·6
14	10·7	9·0	74	56·7	47·6	134	102·6	86·1	194	148·6	124·7	254	194·6	163·3
15	11·5	9·6	75	57·5	48·2	135	103·4	86·8	195	149·4	125·3	255	195·3	163·9
16	12·3	10·3	76	58·2	48·9	136	104·2	87·4	196	150·1	126·0	256	196·1	164·6
17	13·0	10·9	77	59·0	49·5	137	104·9	88·1	197	150·9	126·6	257	196·9	165·2
18	13·8	11·6	78	59·8	50·1	138	105·7	88·7	198	151·7	127·2	258	197·6	165·8
19	14·6	12·2	79	60·5	50·8	139	106·5	89·3	199	152·4	127·9	259	198·4	166·5
20	15·3	12·9	80	61·3	51·4	140	107·2	90·0	200	153·2	128·6	260	199·2	167·1
21	16·1	13·5	81	62·0	52·1	141	108·0	90·6	201	154·0	129·2	261	199·9	167·8
22	16·9	14·1	82	62·8	52·7	142	108·8	91·3	202	154·7	129·8	262	200·7	168·4
23	17·6	14·8	83	63·6	53·4	143	109·5	91·9	203	155·5	130·5	263	201·5	169·1
24	18·4	15·4	84	64·3	54·0	144	110·3	92·6	204	156.3	131·1	264	202·2	169·7
25	19·2	16·1	85	65·1	54·6	145	111·1	93·2	205	157.0	131·8	265	203·0	170·3
26	19·9	16·7	86	65·9	55·3	146	111·8	93·8	206	157·8	132·4	266	203·8	171·0
27	20·7	17·4	87	66·6	55·9	147	112·6	94·5	207	158·6	133·1	267	204·5	171·6
28	21·4	18·0	88	67·4	56·6	148	113·4	95·1	208	159·3	133·7	268	205·3	172·3
29	22·2	18·6	89	68·2	57·2	149	114·1	95·8	209	160·1	134·3	269	206·1	172·9
30	23·0	19·3	90	68·9	57·9	150	114·9	96·4	210	160·9	135·0	270	206·8	173·6
31	23·7	19·9	91	69·7	58·5	151	115·7	97·1	211	161·6	135·6	271	207·6	174·2
32	24·5	20·6	92	70·5	59·1	152	116·4	97·7	212	162·4	136·3	272	208·4	174·8
33	25·3	21·2	93	71·2	59·8	153	117·2	98·3	213	163·2	136·9	273	209·1	175·5
34	26·0	21·9	94	72·0	60·4	154	118.0	99·0	214	163·9	137·6	274	209·9	176·1
35	26·8	22·5	95	72·8	61·1	155	118·7	99·6	215	164·7	138·2	275	210·7	176·8
36	27·6	23·1	96	73·5	61·7	156	119·5	100·3	216	165·5	138·8	276	211·4	177·4
37	28·3	23·8	97	74·3	62·4	157	120·3	100·9	217	166·2	139·5	277	212·2	178·1
38	29·1	24·4	98	75·1	63·0	158	121·0	101·6	218	167·0	140·1	278	213·0	178·7
39	29·9	25·1	99	75·8	63·6	159	121·8	102·2	219	167·8	140·8	279	213·7	179·3
40	30·6	25·7	100	76·6	64·3	160	122·6	102·8	220	168·5	141·4	280	214·5	180·0
41	31·4	26·4	101	77·4	64·9	161	123·3	103·5	221	169·3	142·1	281	215·3	180·6
42	32·2	27·0	102	78·1	65·6	162	124·1	104·1	222	170·1	142·7	282	216·0	181·3
43	32·9	27·6	103	78·9	66·2	163	124·9	104·8	223	170·8	143·3	283	216·8	181·9
44	33·7	28·3	104	79·7	66·8	164	125·6	105·4	224	171·6	144·0	284	217·6	182·6
45	34·5	28·9	105	80·4	67·5	165	126·4	106·1	225	172·4	144·6	285	218·3	183·2
46	35·2	29·6	106	81·2	68·1	166	127·2	106·7	226	173·1	145·3	286	219·1	183·8
47	36·0	30·2	107	82·0	68·8	167	127·9	107·3	227	173·9	145·9	287	219·9	184·5
48	36·8	30·9	108	82·7	69·4	168	128·7	108·0	228	174·7	146·6	288	220·6	185·1
49	37·5	31·5	109	83·5	70·1	169	129·5	108·6	229	175·4	147·2	289	221·4	185·8
50	38·3	32·1	110	84·3	70·7	170	130·2	109·3	230	176·2	147·8	290	222·2	186·4
51	39·1	32·8	111	85·0	71·3	171	131·0	109·9	231	177·0	148·5	291	222·9	187·1
52	39·8	33·4	112	85·8	72·0	172	131·8	110·6	232	177·7	149·1	292	223·7	187·7
53	40·6	34·1	113	86·6	72·6	173	132·5	111·2	233	178·5	149·8	293	224·5	188·3
54	41·4	34·7	114	87·3	73·3	174	133·3	111·8	234	179·3	150·4	294	225·2	189·0
55	42·1	35·4	115	88·1	73·9	175	134·1	112·5	235	180·0	151·1	295	226·0	189·6
56	42·9	36·0	116	88·9	74·6	176	134·8	113·1	236	180·8	151·7	296	226·7	190·3
57	43·7	36·6	117	89·6	75·2	177	135·6	113·8	237	181·6	152·3	297	227·5	190·9
58	44·4	37·3	118	90·4	75·8	178	136·4	114·4	238	182·3	153·0	298	228·3	191·6
59	45·2	37·9	119	91·2	76·5	179	137·1	115·1	239	183·1	153·6	299	229·0	192·2
60	46·0	38·6	120	91·9	77·1	180	137·9	115·7	240	183·9	154 3	300	229·8	192·8
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

50° = 3 h. 20 m.

TABLE 2.

Traverse Table to 41 Degrees = 2h. 44m

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	0·8	0·7	61	46·0	40·0	121	91·3	79·4	181	136·6	118·7	241	181·9	158·1
2	1·5	1·3	62	46·8	40·7	122	92·1	80·0	182	137·4	119·4	242	182·6	158·8
3	2·3	2·0	63	47·5	41·3	123	92·8	80·7	183	138·1	120·1	243	183·4	159·3
4	3·0	2·6	64	48·3	42·0	124	93·6	81·4	184	138·9	120·7	244	184·1	160·1
5	3·8	3·3	65	49·1	42·7	125	94·3	82·0	185	139·6	121·4	245	184·9	160·7
6	4·5	3·9	66	49·8	43·3	126	95·1	82·7	186	140·4	122·0	246	185·7	161·4
7	5·3	4·6	67	50·6	44·0	127	95·8	83·3	187	141·1	122·7	247	186·4	162·0
8	6·0	5·2	68	51·3	44·6	128	96·6	84·0	188	141·9	123·3	248	187·2	162·7
9	6·8	5·9	69	52·1	45·3	129	97·4	84·6	189	142·6	124·0	249	187·9	163·4
10	7·5	6·6	70	52·8	45·9	130	98·1	85·3	190	143·4	124·7	250	188·7	164·0
11	8·3	7·2	71	53·6	46·6	131	98·9	85·9	191	144·1	125·3	251	189·4	164·7
12	9·1	7·9	72	54·3	47·2	132	99·6	86·6	192	144·9	126·0	252	190·2	165·3
13	9·8	8·5	73	55·1	47·9	133	100·4	87·3	193	145·7	126·6	253	190·9	166·0
14	10·6	9·2	74	55·8	48·5	134	101·1	87·9	194	146·4	127·3	254	191·7	166·6
15	11·3	9·8	75	56·6	49·2	135	101·9	88·6	195	147·2	127·9	255	192·5	167·3
16	12·1	10·5	76	57·4	49·9	136	102·6	89·2	196	147·9	128·6	256	193·2	168·0
17	12·8	11·2	77	58·1	50·5	137	103·4	89·9	197	148·7	129·2	257	194·0	168·6
18	13·6	11·8	78	58·9	51·2	138	104·1	90·5	198	149·4	129·9	258	194·7	169·3
19	14·3	12·5	79	59·6	51·8	139	104·9	91·2	199	150·2	130·6	259	195·5	169·9
20	15·1	13·1	80	60·4	52·5	140	105·7	91·8	200	150·9	131·2	260	196·2	170·6
21	15·8	13·8	81	61·1	53·1	141	106·4	92·5	201	151·7	131·9	261	197·0	171·2
22	16·6	14·4	82	61·9	53·8	142	107·2	93·2	202	152·5	132·5	262	197·7	171·9
23	17·4	15·1	83	62·6	54·5	143	107·9	93·8	203	153·2	133·2	263	198·5	172·5
24	18·1	15·7	84	63·4	55·1	144	108·7	94·5	204	154·0	133·8	264	199·2	173·2
25	18·9	16·4	85	64·2	55·8	145	109·4	95·1	205	154·7	134·5	265	200·0	173·9
26	19·6	17·1	86	64·9	56·4	146	110·2	95·8	206	155·5	135·1	266	200·8	174·5
27	20·4	17·7	87	65·7	57·1	147	110·9	96·4	207	156·2	135·8	267	201·5	175·2
28	21·1	18·4	88	66·4	57·7	148	111·7	97·1	208	157·0	136·5	268	202·3	175·8
29	21·9	19·0	89	67·2	58·4	149	112·5	97·8	209	157·7	137·1	269	203·0	176·5
30	22·6	19·7	90	67·9	59·0	150	113·2	98·4	210	158·5	137·8	270	203·8	177·1
31	23·4	20·3	91	68·7	59·7	151	114·0	99·1	211	159·2	138·4	271	204·5	177·8
32	24·2	21·0	92	69·4	60·4	152	114·7	99·7	212	160·0	139·1	272	205·3	178·4
33	24·9	21·6	93	70·2	61·0	153	115·5	100·4	213	160·8	139·7	273	206·0	179·1
34	25·7	22·3	94	70·9	61·7	154	116·2	101·0	214	161·5	140·4	274	206·8	179·8
35	26·4	23·0	95	71·7	62·3	155	117·0	101·7	215	162·3	141·1	275	207·5	180·4
36	27·2	23·6	96	72·5	63·0	156	117·7	102·3	216	163·0	141·7	276	208·3	181·1
37	27·9	24·3	97	73·2	63·6	157	118·5	103·0	217	163·8	142·4	277	209·1	181·7
38	28·7	24·9	98	74·0	64·3	158	119·2	103·7	218	164·5	143·0	278	209·8	182·4
39	29·4	25·6	99	74·7	64·9	159	120·0	104·3	219	165·3	143·7	279	210·6	183·0
40	30·2	26·2	100	75·5	65·6	160	120·8	105·0	220	166·0	144·3	280	211·3	183·7
41	30·9	26·9	101	76·2	66·3	161	121·5	105·6	221	166·8	145·0	281	212·1	184·4
42	31·7	27·6	102	77·0	66·9	162	122·3	106·3	222	167·5	145·6	282	212·8	185·0
43	32·5	28·2	103	77·7	67·6	163	123·0	106·9	223	168·3	146·3	283	213·6	185·7
44	33·2	28·9	104	78·5	68·2	164	123·8	107·6	224	169·1	147·0	284	214·3	186·3
45	34·0	29·5	105	79·2	68·9	165	124·5	108·2	225	169·8	147·6	285	215·1	187·0
46	34·7	30·2	106	80·0	69·5	166	125·3	108·9	226	170·6	148·3	286	215·8	187·6
47	35·5	30·8	107	80·8	70·2	167	126·0	109·6	227	171·3	148·9	287	216·6	188·3
48	36·2	31·5	108	81·5	70·9	168	126·8	110·2	228	172·1	149·6	288	217·4	188·9
49	37·0	32·1	109	82·3	71·5	169	127·5	110·9	229	172·8	150·2	289	218·1	189·6
50	37·7	32·8	110	83·0	72·2	170	128·3	111·5	230	173·6	150·9	290	218·9	190·3
51	38·5	33·5	111	83·8	72·8	171	129·1	112·2	231	174·3	151·5	291	219·6	190·9
52	39·2	34·1	112	84·5	73·5	172	129·8	112·8	232	175·1	152·2	292	220·4	191·6
53	40·0	34·8	113	85·3	74·1	173	130·6	113·5	233	175·8	152·9	293	221·1	192·2
54	40·8	35·4	114	86·0	74·8	174	131·3	114·2	234	176·6	153·5	294	221·9	192·9
55	41·5	36·1	115	86·8	75·4	175	132·1	114·8	235	177·4	154·2	295	222·6	193·5
56	42·3	36·7	116	87·5	76·1	176	132·8	115·5	236	178·1	154·8	296	223·4	194·2
57	43·0	37·4	117	88·3	76·8	177	133·6	116·1	237	178·9	155·5	297	224·1	194·8
58	43·8	38·1	118	89·1	77·4	178	134·3	116·8	238	179·6	156·1	298	224·9	195·5
59	44·5	38·7	119	89·8	78·1	179	135·1	117·4	239	180·4	156·8	299	225·7	196·2
60	45·3	39·4	120	90·6	78·7	180	135·8	118·1	240	181·1	157·5	300	226·4	196·8
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

49° = 3h. 16m.

TABLE 2.

Traverse Table to 42 Degrees = 2h. 48m.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	0·7	0·7	61	45·3	40·8	121	89·9	81·0	181	134·5	121·1	241	179·1	161·3
2	1·5	1·3	62	46·1	41·5	122	90·7	81·6	182	135·3	121·8	242	179·8	161·9
3	2·2	2·0	63	46·8	42·2	123	91·4	82·3	183	136·0	122·5	243	180·6	162·6
4	3·0	2·7	64	47·6	42·8	124	92·1	83·0	184	136·7	123·1	244	181·3	163·3
5	3·7	3·3	65	48·3	43·5	125	92·9	83·6	185	137·5	123·8	245	182·1	163·9
6	4·5	4·0	66	49·0	44·2	126	93·6	84·3	186	138·2	124·5	246	182·8	164·6
7	5·2	4·7	67	49·8	44·8	127	94·4	85·0	187	139·0	125·1	247	183·6	165·3
8	5·9	5·4	68	50 5	45·5	128	95·1	85·6	188	139·7	125·8	248	184·3	165·9
9	6·7	6·0	69	51·3	46·2	129	95·9	86·3	189	140·5	126·5	249	185·0	166·6
10	7·4	6·7	70	52·1	46·8	130	96·6	87·0	190	141·2	127·1	250	185·8	167·3
11	8·2	7·4	71	52·8	47·5	131	97·4	87·7	191	141·9	127·8	251	186·5	168·0
12	8·9	8·0	72	53·5	48·2	132	98·1	88·3	192	142·7	128·5	252	187·3	168·6
13	9·7	8·7	73	54·2	48·8	133	98·8	89·0	193	143·4	129·1	253	188·0	169·3
14	10·4	9·4	74	55·0	49·5	134	99·6	89·7	194	144·2	129·8	254	188·8	170·0
15	11·1	10·0	75	55·7	50·2	135	100·3	90·3	195	144·9	130·5	255	189·5	170·6
16	11·9	10·7	76	56·5	50·9	136	101·1	91·0	196	145·7	131·1	256	190·2	171·3
17	12·6	11·4	77	57·2	51·5	137	101·8	91·7	197	146·4	131·8	257	191·0	172·0
18	13·4	12·0	78	58·0	52·2	138	102·6	92·3	198	147·1	132·5	258	191·7	172·6
19	14·1	12·7	79	58·7	52·9	139	103·3	93·0	199	147·9	133·2	259	192·5	173·3
20	14·9	13·4	80	59·5	53·5	140	104·0	93·7	200	148·6	133·8	260	193·2	174·0
21	15·6	14·1	81	60·2	54·2	141	104·8	94·3	201	149·4	134·5	261	194·0	174·6
22	16·3	14·7	82	60·9	54·9	142	105·5	95·0	202	150·1	135·2	262	194·7	175·3
23	17·1	15·4	83	61·7	55·5	143	106·3	95·7	203	150·9	135·8	263	195·4	176·0
24	17·8	16·1	84	62·4	56·2	144	107·0	96·4	204	151·6	136·5	264	196·2	176·7
25	18·6	16·7	85	63·2	56·9	145	107·8	97·0	205	152·3	137·2	265	196·9	177·3
26	19·3	17·4	86	63·9	57·5	146	108·5	97·7	206	153·1	137·8	266	197·7	178·0
27	20·1	18·1	87	64·7	58·2	147	109·2	98·4	207	153·8	138·5	267	198·4	178·7
28	20·8	18·7	88	65·4	58·9	148	110·0	99·0	208	154·6	139·2	268	199·2	179·3
29	21·6	19·4	89	66·1	59·6	149	110·7	99·7	209	155·3	139·8	269	199·9	180·0
30	22·3	20·1	90	66·9	60·2	150	111·5	100·4	210	156·1	140·5	270	200·6	180·7
31	23·0	20·7	91	67·6	60·9	151	112·2	101·0	211	156·8	141·2	271	201·4	181·3
32	23·8	21·4	92	68·4	61·6	152	113·0	101·7	212	157·5	141·9	272	202·1	182·0
33	24·5	22·1	93	69·1	62·2	153	113·7	102·4	213	158·3	142·5	273	202·9	182·7
34	25·3	22·8	94	69·9	62·9	154	114·4	103·0	214	159·0	143·2	274	203·6	183·3
35	26·0	23·4	95	70·6	63·6	155	115·2	103·7	215	159·8	143·9	275	204·4	184·0
36	26·8	24·1	96	71·3	64·2	156	115·9	104·4	216	160·5	144·5	276	205·1	184·7
37	27·5	24·8	97	72·1	64·9	157	116·7	105·1	217	161·3	145·2	277	205·9	185·3
38	28·2	25·4	98	72·8	65·6	158	117·4	105·7	218	162·0	145·9	278	206·6	186·0
39	29·0	26·1	99	73·6	66·2	159	118·2	106·4	219	162·7	146·5	279	207·3	186·7
40	29·7	26·8	100	74·3	66·9	160	118·9	107·1	220	163·5	147·2	280	208·1	187·4
41	30·5	27·4	101	75·1	67·6	161	119·6	107·7	221	164·2	147·9	281	208·8	188·0
42	31·2	28·1	102	75·8	68·3	162	120·4	108·4	222	165·0	148·5	282	209·6	188·7
43	32·0	28·8	103	76·5	68·9	163	121·1	109·1	223	165·7	149·2	283	210·3	189·4
44	32·7	29·4	104	77·3	69·6	164	121·9	109·7	224	166·5	149·9	284	211·1	190·0
45	33·4	30·1	105	78·0	70·3	165	122·6	110·4	225	167·2	150·6	285	211·8	190·7
46	34·2	30·8	106	78·8	70·9	166	123·4	111·1	226	168·0	151·2	286	212·5	191·4
47	34·9	31·4	107	79·5	71·6	167	124·1	111·7	227	168·7	151·9	287	213·3	192·0
48	35·7	32·1	108	80·3	72·3	168	124·8	112·4	228	169·4	152·6	288	214·0	192·7
49	36·4	32·8	109	81·0	72·9	169	125·6	113·1	229	170·2	153·2	289	214·8	193·4
50	37·2	33·5	110	81·7	73·6	170	126·3	113·8	230	170·9	153·9	290	215·5	194·0
51	37·9	34·1	111	82·5	74·3	171	127·1	114·4	231	171·7	154·6	291	216·3	194·7
52	38·6	34·8	112	83·2	74·9	172	127·8	115·1	232	172·4	155·2	292	217·0	195·4
53	39·4	35·5	113	84·0	75·6	173	128·6	115·8	233	173·2	155·9	293	217·7	196·1
54	40·1	36·1	114	84·7	76·3	174	129·3	116·4	234	173·9	156·6	294	218·5	196·7
55	40·9	36·8	115	85·5	77·0	175	130·1	117·1	235	174·6	157·2	295	219·2	197·4
56	41·6	37·5	116	86·2	77·6	176	130·8	117·8	236	175·4	157·9	296	220·0	198·1
57	42·4	38·1	117	86·9	78·3	177	131·5	118·4	237	176·1	158·6	297	220·7	198·7
58	43·1	38·8	118	87·7	79·0	178	132·3	119·1	238	176·9	159·3	298	221·5	199·4
59	43·8	39·5	119	88·4	79·6	179	133·0	119·8	239	177·6	159·9	299	222·2	200·1
60	44·6	40·1	120	89·2	80·3	180	133·8	120·4	240	178·4	160·6	300	222.9	200·7
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

48° = 3h. 12m.

TABLE 2.

Traverse Table to 43 Degrees ≐ 2h. 52m.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	0·7	0·7	61	44·6	41·6	121	88·5	82·5	181	132·4	123·4	241	176·3	164·4
2	1·5	1·4	62	45·3	42·3	122	89·2	83·2	182	133·1	124·1	242	177·0	165·0
3	2·2	2·0	63	46·1	43·0	123	90·0	83·9	183	133·8	124·8	243	177·7	165·7
4	2·9	2·7	64	46·8	43·6	124	90·7	84·6	184	134·6	125·5	244	178·5	166·4
5	3·7	3·4	65	47·5	44·3	125	91·4	85·2	185	135·3	126·2	245	179·2	167·1
6	4·4	4·1	66	48·3	45·0	126	92·2	85·9	186	136·0	126·9	246	179·9	167·8
7	5·1	4·8	67	49·0	45·7	127	92·9	86·6	187	136·8	127·5	247	180·6	168. 5
8	5·9	5·5	68	49·7	46·4	128	93·6	87·3	188	137·5	128·2	248	181·4	169·1
9	6·6	6·1	69	50·5	47·1	129	94·3	88·0	189	138·2	128 9	249	182·1	169·8
10	7·3	6·8	70	51·2	47·7	130	95·1	88·7	190	139·0	129·6	250	182·8	170·5
11	8·0	7·5	71	51·9	48·4	131	95·8	89·3	191	139·7	130·3	251	183·6	171·2
12	8·8	8·2	72	52·7	49·1	132	96·5	90·0	192	140·4	130·9	252	184·3	171·9
13	9·5	8·9	73	53·4	49·8	133	97·3	90·7	193	141·2	131·6	253	185·0	172·5
14	10·2	9·5	74	54·1	50·5	134	98·0	91·4	194	141·9	132·3	254	185·8	173·2
15	11·0	10·2	75	54·9	51·1	135	98·7	92·1	195	142·6	133·0	255	186·5	173·9
16	11·7	10·9	76	55·6	51·8	136	99·5	92 8	196	143·3	133·7	256	187·2	174·6
17	12·4	11·6	77	56·3	52·5	137	100·2	93·4	197	144·1	134·4	257	188·0	175·2
18	13·2	12·3	78	57·0	53·2	138	100·9	94·1	198	144·8	135·0	258	188·7	176·0
19	13·9	13·0	79	57·8	53·9	139	101·7	94·8	199	145·5	135·7	259	189·4	176·6
20	14·6	13·6	80	58·5	54·6	140	102·4	95·5	200	146·3	136·4	260	190·2	177·3
21	15·4	14·3	81	59·2	55·2	141	103·1	96·2	201	147·0	137·1	261	190·9	178·0
22	16·1	15·0	82	60·0	55·9	142	103·9	96·8	202	147·7	137·8	262	191·6	178·7
23	16·8	15·7	83	60·7	56·6	143	104·6	97·5	203	148·5	138·4	263	192·3	179·4
24	17·6	16·4	84	61·4	57·3	144	105·3	98·2	204	149·2	139·1	264	193·1	180·0
25	18·3	17·0	85	62·2	58·0	145	106·0	98·9	205	149·9	139·8	265	193·8	180·7
26	19·0	17·7	86	62·9	58·7	146	106·8	99·6	206	150·7	140·5	266	194·5	181·4
27	19·7	18·4	87	63·6	59·3	147	107·5	100·3	207	151·4	141·2	267	195·3	182·1
28	20·5	19·1	88	64·4	60·0	148	108·2	100·9	208	152·1	141·9	268	196·0	182·8
29	21·2	19·8	89	65·1	60·7	149	109·0	101·6	209	152·9	142·5	269	196·7	183·5
30	21·9	20·5	90	65·8	61·4	150	109·7	102·3	210	153·6	143·2	270	197·5	184·1
31	22·7	21·1	91	66·6	62·1	151	110·4	103·0	211	154·3	143·9	271	198·2	184·8
32	23·4	21·8	92	67·3	62·7	152	111·2	103·7	212	155·0	144·6	272	198·9	185·5
33	24·1	22·5	93	68·0	63·4	153	111·9	104·3	213	155·8	145·3	273	199·7	186·2
34	24·9	23·2	94	68·7	64·1	154	112·6	105·0	214	156·5	145·9	274	200·4	186·9
35	25·6	23·9	95	69·5	64·8	155	113·4	105·7	215	157·2	146·6	275	201·1	187·5
36	26·3	24·6	96	70·2	65·5	156	114·1	106·4	216	158·0	147·3	276	201·9	188·2
37	27·1	25·2	97	70·9	66·2	157	114·8	107·1	217	158. 7	148·0	277	202·6	188·9
38	27·8	25·9	98	71·7	66·8	158	115·6	107·8	218	159·4	148·7	278	203·3	189·6
39	28·5	26·6	99	72·4	67·5	159	116·3	108·4	219	160·2	149·4	279	204·0	190·3
40	29·3	27·3	100	73·1	68·2	160	117·0	109·1	220	160·9	150·0	280	204·8	191·0
41	30·0	28·0	101	73·9	68·9	161	117·7	109·8	221	161·6	150·7	281	205·5	191·6
42	30·7	28·6	102	74·6	69·6	162	118·5	110·5	222	162·4	151·4	282	206·2	192·3
43	31·4	29·3	103	75·3	70·2	163	119·2	111·2	223	163·1	152·1	283	207·0	193·0
44	32·2	30·0	104	76·1	70·9	164	119·9	111·8	224	163·8	152·8	284	207·7	193·7
45	32·9	30·7	105	76·8	71·6	165	120·7	112·5	225	164·6	153·4	285	208·4	194·4
46	33·6	31·4	106	77·5	72·3	166	121·4	113·2	226	165·3	154·1	286	209·2	195·1
47	34·4	32·1	107	78·3	73·0	167	122·1	113·9	227	166·0	154·8	287	209·9	195·7
48	35·1	32·7	108	79·0	73·7	168	122·9	114·6	228	166·7	155·5	288	210·6	196·4
49	35·8	33·4	109	79·7	74·3	169	123·6	115·3	229	167·5	156·2	289	211·4	197·1
50	36·6	34·1	110	80·4	75·0	170	124·3	115·9	230	168·2	156·9	290	212·1	197·8
51	37·3	34·8	111	81·2	75·7	171	125·1	116·6	231	168·9	157·5	291	212·8	198·5
52	38·0	35·5	112	81·9	76·4	172	125·8	117·3	232	169·7	158·2	292	213·6	199·1
53	38·8	36·1	113	82·6	77·1	173	126·5	118 0	233	170·4	158·9	293	214·3	199·8
54	39·5	36·8	114	83·4	77·7	174	127·3	118·7	234	171·1	159·6	294	215·0	200·5
55	40·2	37·5	115	84·1	78·4	175	128·0	119·3	235	171·9	160·3	295	215·7	201·2
56	41·0	38·2	116	84·8	79·1	176	128·7	120·0	236	172·6	161·0	296	216·5	201·9
57	41·7	38·9	117	85·6	79·8	177	129·4	120·7	237	173·3	161·6	297	217·2	202·6
58	42·4	39·6	118	86·3	80·5	178	130·2	121·4	238	174·1	162·3	298	217·9	203·2
59	43·1	40·2	119	87·0	81·2	179	130·9	122·1	239	174·8	163·0	299	218·7	203·9
60	43·9	40·9	120	87·8	81·8	180	131·6	122·8	240	175·5	163·7	300	219·4	204·6
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

TABLE 2.

Traverse Table to 44 Degrees = 2h. 56m.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	0·7	0·7	61	43·9	42·4	121	87·0	84·1	181	130·2	125·7	241	173·4	167·4
2	1·4	1·4	62	44·6	43·1	122	87·8	84·7	182	130·9	126·4	242	174·1	168·1
3	2·2	2·1	63	45·3	43·8	123	88·5	85·4	183	131·6	127·1	243	174·8	168·8
4	2·9	2·8	64	46·0	44·5	124	89·2	86·1	184	132·4	127·8	244	175·5	169·5
5	3·6	3·5	65	46·8	45·2	125	89·9	86·8	185	133·1	128·5	245	176·2	170·2
6	4·3	4·2	66	47·5	45·8	126	90·6	87·5	186	133·8	129·2	246	177·0	170·9
7	5·0	4·9	67	48·2	46·5	127	91·4	88·2	187	134·5	129·9	247	177·7	171·6
8	5·8	5·6	68	48·9	47·2	128	92·1	88·9	188	135·2	130·6	248	178·4	172·3
9	6·5	6·3	69	49·6	47·9	129	92·8	89·6	189	136·0	131·3	249	179·1	173·0
10	7·2	6·9	70	50·4	48·6	130	93·5	90·3	190	136·7	132·0	250	179·8	173·7
11	7·9	7·6	71	51·1	49·3	131	94·2	91·0	191	137·4	132·7	251	180·6	174·4
12	8·6	8·3	72	51·8	50·0	132	95·0	91·7	192	138·1	133·4	252	181·3	175·1
13	9·4	9·0	73	52·5	50·7	133	95·7	92·4	193	138·8	134·1	253	182·0	175·7
14	10·1	9·7	74	53·2	51·4	134	96·4	93·1	194	139·6	134·8	254	182·7	176·4
15	10·8	10·4	75	54·0	52·1	135	97·1	93·8	195	140·3	135·5	255	183·4	177·1
16	11·5	11·1	76	54·7	52·8	136	97·8	94·5	196	141·0	136·2	256	184·2	177·8
17	12·2	11·8	77	55·4	53·5	137	98·5	95·2	197	141·7	136·8	257	184·9	178·5
18	12·9	12·5	78	56·1	54·2	138	99·3	95·9	198	142·4	137·5	258	185·6	179·2
19	13·7	13·2	79	56·8	54·9	139	100·0	96·6	199	143·1	138·2	259	186·3	179·9
20	14·4	13·9	80	57·5	55·6	140	100·7	97·3	200	143·9	138·9	260	187·0	180·6
21	15·1	14·6	81	58·3	56·3	141	101·4	97·9	201	144·6	139·6	261	187·7	181·3
22	15·8	15·3	82	59·0	57·0	142	102·1	98·6	202	145·3	140·3	262	188·5	182·0
23	16·5	16·0	83	59·7	57·7	143	102·9	99·3	203	146·0	141·0	263	189·2	182·7
24	17·3	16·7	84	60·4	58·4	144	103·6	100·0	204	146·7	141·7	264	189·9	183·4
25	18·0	17·4	85	61·1	59·0	145	104·3	100·7	205	147·5	142·4	265	190·6	184·1
26	18·7	18·1	86	61·9	59·7	146	105·0	101·4	206	148·2	143·1	266	191·3	184·8
27	19·4	18·8	87	62·6	60·4	147	105·7	102·1	207	148·9	143·8	267	192·1	185·5
28	20·1	19·5	88	63·3	61·1	148	106·5	102·8	208	149·6	144·5	268	192·8	186·2
29	20·9	20·1	89	64·0	61·8	149	107·2	103·5	209	150·3	145·2	269	193·5	186·9
30	21·6	20·8	90	64·7	62·5	150	107·9	104·2	210	151·1	145·9	270	194·2	187·6
31	22·3	21·5	91	65·5	63·2	151	108·6	104·9	211	151·8	146·6	271	194·9	188·3
32	23·0	22·2	92	66·2	63·9	152	109·3	105·6	212	152·5	147·3	272	195·7	188·9
33	23·7	22·9	93	66·9	64·6	153	110·1	106·3	213	153·2	148·0	273	196·4	189·6
34	24·5	23·6	94	67·6	65·3	154	110·8	107·0	214	153·9	148·7	274	197·1	190·3
35	25·2	24·3	95	68·3	66·0	155	111·5	107·7	215	154·7	149·4	275	197·8	191·0
36	25·9	25·0	96	69·1	66·7	156	112·2	108·4	216	155·4	150·0	276	198·5	191·7
37	26·6	25·7	97	69·8	67·4	157	112·9	109·1	217	156·1	150·7	277	199·3	192·4
38	27·3	26·4	98	70·5	68·1	158	113·7	109·8	218	156·8	151·4	278	200·0	193·1
39	28·1	27·1	99	71·2	68·8	159	114·4	110·5	219	157·5	152·1	279	200·7	193·8
40	28·8	27·8	100	71·9	69·5	160	115·1	111·1	220	158·3	152·8	280	201·4	194·5
41	29·5	28·5	101	72·7	70·2	161	115·8	111·8	221	159·0	153·5	281	202·1	195·2
42	30·2	29·2	102	73·4	70·9	162	116·5	112·5	222	159·7	154·2	282	202·9	195·9
43	30·9	29·9	103	74·1	71·5	163	117·3	113·2	223	160·4	154·9	283	203·6	196·6
44	31·7	30·6	104	74·8	72·2	164	118·0	113·9	224	161·1	155·6	284	204·3	197·3
45	32·4	31·3	105	75·5	72·9	165	118·7	114·6	225	161·9	156·3	285	205·0	198·0
46	33·1	32·0	106	76·3	73·6	166	119·4	115·3	226	162·6	157·0	286	205·7	198·7
47	33·8	32·6	107	77·0	74·3	167	120·1	116·0	227	163·3	157·7	287	206·5	199·4
48	34·5	33·3	108	77·7	75·0	168	120·8	116·7	228	164·0	158·4	288	207·2	200·1
49	35·2	34·0	109	78·4	75·7	169	121·6	117·4	229	164·7	159·1	289	207·9	200·8
50	36·0	34·7	110	79·1	76·4	170	122·3	118·1	230	165·4	159·8	290	208·6	201·5
51	36·7	35·4	111	79·8	77·1	171	123·0	118·8	231	166·2	160·5	291	209·3	202·1
52	37·4	36·1	112	80·6	77·8	172	123·7	119·5	232	166·9	161·2	292	210·0	202·8
53	38·1	36·8	113	81·3	78·5	173	124·4	120·2	233	167·6	161·9	293	210·8	203·5
54	38·8	37·5	114	82·0	79·2	174	125·2	120·9	234	168·3	162·6	294	211·5	204·2
55	39·6	38·2	115	82·7	79·9	175	125·9	121·6	235	169·0	163·2	295	212·2	204·9
56	40·3	38·9	116	83·4	80·6	176	126·6	122·3	236	169·8	163·9	296	212·9	205·6
57	41·0	39·6	117	84·2	81·3	177	127·3	123·0	237	170·5	164·6	297	213·6	206·3
58	41·7	40·3	118	84·9	82·0	178	128·0	123·6	238	171·2	165·3	298	214·4	207·0
59	42·4	41·0	119	85·6	82·7	179	128·8	124·3	239	171·9	166·0	299	215·1	207·7
60	43·2	41·7	120	86·3	83·4	180	129·5	125·0	240	172·6	166·7	300	215·8	208·4
Dist	Dep.	Lat.	D.st	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

46° = 3h. 4m.

Traverse Table to 45 Degrees=3h. 0m.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	0·7	0·7	61	43·1	43·1	121	85·6	85·6	181	128·0	128·0	241	170·4	170·4
2	1·4	1·4	62	43·8	43·8	122	86·3	86·3	182	128·7	128·7	242	171·1	171·1
3	2·1	2·1	63	44·5	44·5	123	87·0	87·0	183	129·4	129·4	243	171·8	171·8
4	2·8	2·8	64	45·3	45·3	124	87·7	87·7	184	130·1	130·1	244	172·5	172·5
5	3·5	3·5	65	46·0	46·0	125	88·4	88·4	185	130·8	130·8	245	173·2	173·2
6	4·2	4·2	66	46·7	46·7	126	89·1	89·1	186	131·5	131·5	246	173·9	173·9
7	4·9	4·9	67	47·4	47·4	127	89·8	89·8	187	132·2	132·2	247	174·7	174·7
8	5·7	5·7	68	48·1	48·1	128	90·5	90·5	188	132·9	132·9	248	175·4	175·4
9	6·4	6·4	69	48·8	48·8	129	91·2	91·2	189	133·6	133·6	249	176·1	176·1
10	7·1	7·1	70	49·5	49·5	130	91·9	91·9	190	134·3	134·3	250	176·8	176·8
11	7·8	7·8	71	50·2	50·2	131	92·6	92·6	191	135·1	135·1	251	177·5	177·5
12	8·5	8·5	72	50·9	50·9	132	93·3	93·3	192	135·8	135·8	252	178·2	178·2
13	9·2	9·2	73	51·6	51·6	133	94·0	94·0	193	136·5	136·5	253	178·9	178·9
14	9·9	9·9	74	52·3	52·3	134	94·8	94·8	194	137·2	137·2	254	179·6	179·6
15	10·6	10·6	75	53·0	53·0	135	95·5	95·5	195	137·9	137·9	255	180·3	180·3
16	11·3	11·3	76	53·7	53·7	136	96·2	96·2	196	138·6	138·6	256	181·0	181·0
17	12·0	12·0	77	54·4	54·4	137	96·9	96·9	197	139·3	139·3	257	181·7	181·7
18	12·7	12·7	78	55·2	55·2	138	97·6	97·6	198	140·0	140·0	258	182·4	182·4
19	13·4	13·4	79	55·9	55·9	139	98·3	98·3	199	140·7	140·7	259	183·1	183·1
20	14·1	14·1	80	56·6	56·6	140	99·0	99·0	200	141·4	141·4	260	183·8	183·8
21	14·8	14·8	81	57·3	57·3	141	99·7	99·7	201	142·1	142·1	261	184·6	184·6
22	15·6	15·6	82	58·0	58·0	142	100·4	100·4	202	142·8	142·8	262	185·3	185·3
23	16·3	16·3	83	58·7	58·7	143	101·1	101·1	203	143·5	143·5	263	186·0	186·0
24	17·0	17·0	84	59·4	59·4	144	101·8	101·8	204	144·2	144·2	264	186·7	186·7
25	17·7	17·7	85	60·1	60·1	145	102·5	102·5	205	145·0	145·0	265	187·4	187·4
26	18·4	18·4	86	60·8	60·8	146	103·2	103·2	206	145·7	145·7	266	188·1	188·1
27	19·1	19·1	87	61·5	61·5	147	103·9	103·9	207	146·4	146·4	267	188·8	188·8
28	19·8	19·8	88	62·2	62·2	148	104·7	104·7	208	147·1	147·1	268	189·5	189·5
29	20·5	20·5	89	62·9	62·9	149	105·4	105·4	209	147·8	147·8	269	190·2	190·2
30	21·2	21·2	90	63·6	63·6	150	106·1	106·1	210	148·5	148·5	270	190·9	190·9
31	21·9	21·9	91	64·3	64·3	151	106·8	106·8	211	149·2	149·2	271	191·6	191·6
32	22·6	22·6	92	65·1	65·1	152	107·5	107·5	212	149·9	149·9	272	192·3	192·3
33	23·3	23·3	93	65·8	65·8	153	108·2	108·2	213	150·6	150·6	273	193·0	193·0
34	24·0	24·0	94	66·5	66·5	154	108·9	108·9	214	151·3	151·3	274	193·7	193·7
35	24·7	24·7	95	67·2	67·2	155	109·6	109·6	215	152·0	152·0	275	194·5	194·5
36	25·5	25·5	96	67·9	67·9	156	110·3	110·3	216	152·7	152·7	276	195·2	195·2
37	26·2	26·2	97	68·6	68·6	157	111·0	111·0	217	153·4	153·4	277	195·9	195·9
38	26·9	26·9	98	69·3	69·3	158	111·7	111·7	218	154·1	154·1	278	196·6	196·6
39	27·6	27·6	99	70·0	70·0	159	112·4	112·4	219	154·9	154·9	279	197·3	197·3
40	28·3	28·3	100	70·7	70·7	160	113·1	113·1	220	155·6	155·6	280	198·0	198·0
41	29·0	29·0	101	71·4	71·4	161	113·8	113·8	221	156·3	156·3	281	198·7	198·7
42	29·7	29·7	102	72·1	72·1	162	114·5	114·5	222	157·0	157·0	282	199·4	199·4
43	30·4	30·4	103	72·8	72·8	163	115·3	115·3	223	157·7	157·7	283	200·1	200·1
44	31·1	31·1	104	73·5	73·5	164	116·0	116·0	224	158·4	158·4	284	200·8	200·8
45	31·8	31·8	105	74·2	74·2	165	116·7	116·7	225	159·1	159·1	285	201·5	201·5
46	32·5	32·5	106	75·0	75·0	166	117·4	117·4	226	159·8	159·8	286	202·2	202·2
47	33·2	33·2	107	75·7	75·7	167	118·1	118·1	227	160·5	160·5	287	202·9	202·9
48	33·9	33·9	108	76·4	76·4	168	118·8	118·8	228	161·2	161·2	288	203·6	203·6
49	34·6	34·6	109	77·1	77·1	169	119·5	119·5	229	161·9	161·9	289	204·3	204·3
50	35·4	35·4	110	77·8	77·8	170	120·2	120·2	230	162·6	162·6	290	205·1	205·1
51	36·1	36·1	111	78·5	78·5	171	120·9	120·9	231	163·3	163·3	291	205·8	205·8
52	36·8	36·8	112	79·2	79·2	172	121·6	121·6	232	164·0	164·0	292	206·5	206·5
53	37·5	37·5	113	79·9	79·9	173	122·3	122·3	233	164·8	164·8	293	207·2	207·2
54	38·2	38·2	114	80·6	80·6	174	123·0	123·0	234	165·5	165·5	294	207·9	207·9
55	38·9	38·9	115	81·3	81·3	175	123·7	123·7	235	166·2	166·2	295	208·6	208·6
56	39·6	39·6	116	82·0	82.0	176	124·4	124·4	236	166·9	166·9	296	209·3	209·3
57	40·3	40·3	117	82·7	82·7	177	125·2	125·2	237	167·6	167·6	297	210.0	210·0
58	41·0	41·0	118	83·4	83 4	178	125·9	125·9	238	168·3	168·3	298	210·7	210·7
59	41·7	41·7	119	84·1	84·1	179	126·6	126·6	239	169·0	169·0	299	211·4	211·4
60	42·4	42·4	120	84 9	84·9	180	127·3	127·3	240	169·7	169·7	300	212·1	212·1
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

45° = 3h. 0m.

TABLE 3.

LOGARITHMIC SINES, TANGENTS, and SECANTS, to every Point and Quarter Point of the Compass.

Points.	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co-sec.	Points.
0	0·000000	10·000000	0·000000	Infinite.	10·000000	Infinite.	8
0 ¼	8·690796	9·999477	8·691319	11·308681	10·000523	11·309204	7 ¾
0 ½	8·991302	9·997904	8·993398	11·006602	10·002096	11·008698	7 ½
0 ¾	9·166520	9·995274	9·171247	10·828753	10 004726	10·833480	7 ¼
1	9·290236	9·991574	9·298662	10·701338	10·008426	10·709764	7
1 ¼	9·385571	9·986786	9·398785	10·601215	10·013214	10·614429	6 ¾
1 ½	9·462824	9·980885	9·481939	10·518061	10·019115	10·537176	6 ½
1 ¾	9·527488	9·973841	9·553647	10·446353	10·026159	10·472512	6 ¼
2	9·582840	9·965615	9·617224	10·382776	10. 034385	10·417160	6
2 ¼	9·630992	9·956163	9·674829	10·325171	10·043837	10·369008	5 ¾
2 ½	9·673387	9·945430	9·727957	10·272043	10·054570	10·326613	5 ½
2 ¾	9·711050	9·933350	9·777700	10·222300	10·066650	10·288950	5 ¼
3	9·744739	9·919846	9·824893	10·175107	10·080154	10·255261	5
3 ¼	9·775027	9·904828	9·870199	10·129801	10·095172	10·224973	4 ¾
3 ½	9·802359	9·888185	9·914173	10·085827	10·111815	10·197641	4 ½
3 ¾	9·827084	9·869790	9·957295	10·042705	10·130210	10·172916	4 ¼
4	9·849485	9·849485	10·000000	10·000000	10·150515	10·150515	4
	Co-sine.	Sine.	Co-tang.	Tangent.	Co-sec.	Secant.	

TABLE 4.

LOGARITHMS OF NUMBERS.

No. 1——100 Log. 0·000000——2·000000

N.	Log.	No.	Log.	No.	Log.	No.	Log.	No	Log.
1	0·000000	21	1·322219	41	1·612784	61	1·785330	81	1·908485
2	0·301030	22	1·342423	42	1·623249	62	1·792392	82	1·913814
3	0·477121	23	1·361728	43	1·633468	63	1·799341	83	1·919078
4	0·602060	24	1·380211	44	1·643453	64	1·806180	84	1·924279
5	0·698970	25	1·397940	45	1·653213	65	1·812913	85	1·929419
6	0·778151	26	1·414973	46	1·662758	66	1·819544	86	1·934498
7	0·845098	27	1·431364	47	1·672098	67	1·826075	87	1. 939519
8	0·903090	28	1·447158	48	1·681241	68	1·832509	88	1. 944483
9	0·954243	29	1·462398	49	1·690196	69	1 838849	89	1·949390
10	1·000000	30	1·477121	50	1·698970	70	1·845098	90	1·954243
11	1·041393	31	1·491362	51	1·707570	71	1·851258	91	1·959041
12	1·079181	32	1·505150	52	1·716003	72	1·857332	92	1·963788
13	1·113943	33	1·518514	53	1·724276	73	1·863323	93	1·968483
14	1·146128	34	1.531479	54	1·732394	74	1·869232	94	1·973128
15	1·176091	35	1·544068	55	1·740363	75	1·875061	95	1·977724
16	1·204120	36	1·556302	56	1·748188	76	1·880814	96	1·982271
17	1·230449	37	1·568202	57	1·755875	77	1·886491	97	1·986772
18	1·255273	38	1·579784	58	1·763428	78	1·892095	98	1·991226
19	1·278754	39	1·591065	59	1·770852	79	1·897627	99	1·995635
20	1·301030	40	1·602060	60	1·778151	80	1·903090	100	2·000000

TABLE 4.

Logarithms of Numbers.

No. 1000——1600 Log. 000000——204120

No.	0	1	2	3	4	5	6	7	8	9	Diff
100	000000	000434	000868	001301	001734	002166	002598	003029	003460	003891	432
101	004321	004751	005180	005609	006038	006466	006894	007321	007748	008174	428
102	008600	009026	009451	009876	010300	010724	011147	011570	011993	012415	424
103	012837	013259	013680	014100	014520	014940	015360	015779	016197	016615	420
104	017033	017451	017868	018284	018700	019116	019532	019947	020361	020775	416
105	021189	021603	022016	022428	022841	023252	023664	024075	024486	024896	412
106	025306	025715	026124	026533	026942	027350	027757	028164	028571	028978	408
107	029384	029789	030195	030600	031004	031408	031812	032216	032619	033021	404
108	033424	033826	034227	034628	035029	035430	035830	036229	036629	037028	400
109	037426	037825	038223	038620	039017	039414	039811	040207	040602	040998	397
110	041393	041787	042182	042575	042969	043362	043755	044148	044540	044931	393
111	045323	045714	046105	046495	046885	047275	047664	048053	048442	048830	390
112	049218	049606	049993	050380	050766	051152	051538	051924	052309	052694	386
113	053078	053463	053846	054230	054613	054996	055378	055760	056142	056524	383
114	056905	057286	057666	058046	058426	058805	059185	059563	059942	060320	379
115	060698	061075	061452	061829	062206	062582	062958	063333	063709	064083	376
116	064458	064832	065206	065580	065953	066326	066699	067071	067443	067814	373
117	068186	068557	068928	069298	069668	070038	070407	070776	071145	071514	370
118	071882	072250	072617	072985	073352	073718	074085	074451	074816	075182	366
119	075547	075912	076276	076640	077004	077368	077731	078094	078457	078819	363
120	079181	079543	079904	080266	080626	080987	081347	081707	082067	082426	360
121	082785	083144	083503	083861	084219	084576	084934	085291	085647	086004	357
122	086360	086716	087071	087426	087781	088136	088490	088845	089198	089552	355
123	089905	090258	090611	090963	091315	091667	092018	092370	092721	093071	352
124	093422	093772	094122	094471	094820	095169	095518	095866	096215	096562	349
125	096910	097257	097604	097951	098297	098644	098990	099335	099681	100026	346
126	100370	100715	101059	101403	101747	102090	102434	102777	103119	103462	343
127	103804	104146	104487	104828	105169	105510	105851	106191	106531	106870	341
128	107210	107549	107888	108227	108565	108903	109241	109578	109916	110253	338
129	110590	110926	111262	111598	111934	112270	112605	112940	113275	113609	335
130	113943	114277	114611	114944	115278	115610	115943	116276	116608	116940	332
131	117271	117603	117934	118265	118595	118926	119256	119586	119915	120245	330
132	120574	120903	121231	121560	121888	122216	122543	122871	123198	123525	328
133	123852	124178	124504	124830	125156	125481	125806	126131	126456	126781	325
134	127105	127429	127752	128076	128399	128722	129045	129368	129690	130012	323
135	130334	130655	130977	131298	131619	131939	132260	132580	132900	133219	321
136	133539	133858	134177	134496	134814	135133	135451	135768	136086	136403	318
137	136721	137037	137354	137670	137987	138303	138618	138934	139249	139564	316
138	139879	140194	140508	140822	141136	141450	141763	142076	142389	142702	314
139	143015	143327	143639	143951	144263	144574	144885	145196	145507	145818	311
140	146128	146438	146748	147058	147367	147676	147985	148294	147603	148911	309
141	149219	149527	149835	150142	150449	150756	151063	151370	151676	151982	307
142	152288	152594	152900	153205	153510	153815	154119	154424	154728	155032	305
143	155336	155640	155943	156246	156549	156852	157154	157457	157759	158061	303
144	158362	158664	158965	159266	159567	159868	160168	160468	160769	161068	300
145	161368	161667	161967	162266	162564	162863	163161	163460	163757	164055	298
146	164353	164650	164947	165244	165541	165838	166134	166430	166726	167022	296
147	167317	167613	167908	168203	168497	168792	169086	169380	169674	169968	294
148	170262	170555	170848	171141	171434	171726	172019	172311	172603	172895	292
149	173186	173478	173769	174060	174351	174641	174932	175222	175512	175802	290
150	176091	176381	176670	176959	177248	177536	177825	178113	178401	178689	288
151	178977	179264	179552	179839	180126	180413	180699	180986	181272	181558	287
152	181844	182129	182415	182700	182985	183270	183554	183839	184123	184407	285
153	184691	184975	185259	185542	185825	186108	186391	186674	186956	187239	283
154	187521	187803	188084	188366	188647	188928	189209	189490	189771	190051	281
155	190332	190612	190892	191171	191451	191730	192010	192289	192567	192846	279
156	193125	193403	193681	193959	194237	194514	194792	195069	195346	195623	278
157	195900	196176	196452	196729	197005	197281	197556	197832	198107	198382	276
158	198657	198932	199206	199481	199755	200029	200303	200577	200850	201124	274
159	201397	201670	201943	202216	202488	202761	203033	203305	203577	203848	272
	0	1	2	3	4	5	6	7	8	9	

TABLE 4.

Logarithms of Numbers.

No. 1600——2200 Log. 204120——342423

No	0	1	2	3	4	5	6	7	8	9	Diff
160	204120	204391	204662	204933	205204	205475	205745	206016	206286	206556	271
161	206826	207095	207365	207634	207903	208172	208441	208710	208978	209247	269
162	209515	209783	210051	210318	210586	210853	211120	211388	211654	211921	267
163	212188	212454	212720	212986	213252	213518	213783	214049	214314	214579	266
164	214844	215109	215373	215638	215902	216166	216430	216694	216957	217221	264
165	217484	217747	218010	218273	218535	218798	219060	219322	219584	219846	262
166	220108	220270	220631	220892	221153	221414	221675	221936	222196	222456	261
167	222716	222976	223236	223496	223755	224015	224274	224533	224792	225051	259
168	225309	225568	225826	226084	226342	226600	226858	227115	227372	227630	258
169	227887	228144	228400	228657	228913	229170	229426	229682	229938	230193	256
170	230449	230704	230960	231215	231470	231724	231979	232233	232488	232742	255
171	232996	233250	233504	233757	234011	234264	234517	234770	235023	235276	253
172	235528	235781	236033	236285	236537	236789	237041	237292	237544	237795	252
173	238046	238297	238548	238799	239049	239299	239550	239800	240050	240300	250
174	240549	240799	241048	241297	241546	241795	242044	242293	242541	242790	249
175	243038	243286	243534	243782	244030	244277	244524	244772	245019	245266	247
176	245513	245759	246006	246252	246499	246745	246991	247236	247482	247728	246
177	247973	248219	248464	248709	248954	249198	249443	249687	249932	250176	245
178	250420	250664	250908	251151	251395	251638	251881	252125	252367	252610	243
179	252853	253096	253338	253580	253822	254064	254306	254548	254790	255031	242
180	255273	255514	255755	255996	256236	256477	256718	256958	257198	257439	241
181	257679	257918	258158	258398	258637	258877	259116	259355	259594	259833	239
182	260071	260310	260548	260787	261025	261263	261501	261738	261976	262214	238
183	262451	262688	262925	263162	263399	263636	263873	264109	264345	264582	237
184	264818	265054	265290	265525	265761	265996	266232	266467	266702	266937	235
185	267172	267406	267641	267875	268110	268344	268578	268812	269046	269279	234
186	269513	269746	269980	270213	270446	270679	270912	271144	271377	271609	233
187	271842	272074	272306	272538	272770	273001	273233	273464	273696	273927	232
188	274158	274389	274620	274850	275081	275311	275542	275772	276002	276232	230
189	276462	276691	276921	277151	277380	277609	277838	278067	278296	278525	229
190	278754	278982	279210	279439	279667	279895	280123	280351	280578	280806	228
191	281033	281261	281488	281715	281942	282169	282395	282622	282849	283075	227
192	283301	283527	283753	283979	284205	284431	284656	284882	285107	285332	226
193	285557	285782	286007	286232	286456	286681	286905	287130	287354	287578	225
194	287802	288025	288249	288473	288696	288920	289143	289366	289589	289812	223
195	290035	290257	290480	290702	290925	291147	291369	291591	291813	292034	222
196	292256	292478	292699	292920	293141	293363	293583	293804	294025	294246	221
197	294466	294687	294907	295127	295347	295567	295787	296007	296226	296446	220
198	296665	296884	297104	297323	297542	297761	297979	298198	298416	298635	219
199	298863	299071	299289	299507	299725	299943	300161	300378	300595	300813	218
200	301030	301247	301464	301681	301898	302114	302331	302547	302764	302980	217
201	303196	303412	303628	303844	304059	304275	304491	304706	304921	305136	216
202	305351	305566	305781	305996	306211	306425	306639	306854	307068	307282	214
203	307496	307710	307924	308137	308351	308564	308778	308991	309204	309417	213
204	309630	309843	310056	310268	310481	310693	310906	311118	311330	311542	212
205	311754	311966	312177	312389	312600	312812	313023	313234	313445	313656	211
206	313867	314078	314289	314499	314710	314920	315130	315340	315550	315760	210
207	315970	316180	316390	316599	316809	317018	317227	317436	317645	317854	209
208	318063	318272	318481	318689	318898	319106	319314	319522	319730	319938	208
209	320146	320354	320562	320769	320977	321184	321391	321598	321805	322012	207
210	322219	322426	322633	322839	323046	323252	323458	323665	323871	324077	206
211	324282	324488	324694	324899	325105	325310	325516	325721	325926	326131	205
212	326336	326541	326745	326950	327155	327359	327563	327767	327972	328176	204
213	328380	328583	328787	328991	329194	329398	329601	329805	330008	330211	203
214	330414	330617	330819	331022	331225	331427	331630	331832	332034	332236	202
215	332438	332640	332842	333044	333246	333447	333649	333850	334051	334253	202
216	334454	334655	334856	335056	335257	335458	335658	335859	336059	336260	201
217	336460	336660	336860	337060	337260	337459	337659	337858	338058	338257	200
218	338456	338656	338855	339054	339253	339451	339650	339849	340047	340246	199
219	340444	340642	340841	341039	341237	341435	341632	341830	342028	342225	198
	0	1	2	3	4	5	6	7	8	9	

TABLE 4.

Logarithms of Numbers.

No. 2200——2800 Log. 342423——447158

No.	0	1	2	3	4	5	6	7	8	9	Diff
220	342423	342620	342817	343014	343212	343409	343606	343802	343999	344196	197
221	344392	344589	344785	344981	345178	345374	345570	345766	345962	346157	196
222	346353	346549	346744	346939	347135	347330	347525	347720	347915	348110	195
223	348305	348500	348694	348889	349083	349278	349472	349666	349860	350054	194
224	350248	350442	350636	350829	351023	351216	351410	351603	351796	351989	193
225	352182	352375	352568	352761	352954	353147	353339	353532	353724	353916	193
226	354108	354301	354493	354685	354876	355068	355260	355452	355643	355834	192
227	356026	356217	356408	356599	356790	356981	357172	357363	357554	357744	191
228	357935	358125	358316	358506	358696	358886	359076	359266	359456	359646	190
229	359835	360025	360215	360404	360593	360783	360972	361161	361350	361539	189
230	361728	361917	362105	362294	362482	362671	362859	363048	363236	363424	188
231	363612	363800	363988	364176	364363	364551	364739	364926	365113	365301	188
232	365488	365675	365862	366049	366236	366423	366610	366796	366983	367169	187
233	367356	367542	367729	367915	368101	368287	368473	368659	368844	369030	186
234	369216	369401	369587	369772	369958	370143	370328	370513	370698	370883	185
235	371068	371253	371437	371622	371806	371991	372175	372360	372544	372728	184
236	372912	373096	373280	373464	373647	373831	374015	374198	374382	374565	184
237	374748	374932	375115	375298	375481	375664	375846	376029	376212	376394	183
238	376577	376759	376942	377124	377306	377488	377670	377852	378034	378216	182
239	378398	378580	378761	378943	379124	379306	379487	379668	379849	380030	181
240	380211	380392	380573	380754	380934	381115	381296	381476	381656	381837	181
241	382017	382197	382377	382557	382737	382917	383097	383277	383456	383636	180
242	383815	383995	384174	384353	384533	384712	384891	385070	385249	385428	179
243	385606	385785	385964	386142	386321	386499	386677	386856	387034	387212	178
244	387390	387568	387746	387923	388101	388279	388456	388634	388811	388989	178
245	389166	389343	389520	389697	389875	390051	390228	390405	390582	390759	177
246	390935	391112	391288	391464	391641	391817	391993	392169	392345	392521	176
247	392697	392873	393048	393224	393400	393575	393751	393926	394101	394277	176
248	394452	394627	394802	394977	395152	395326	395501	395676	395850	396025	175
249	396199	396374	396548	396722	396896	397071	397245	397418	397592	397766	174
250	397940	398114	398287	398461	398634	398808	398981	399154	399327	399501	173
251	399674	399847	400020	400192	400365	400538	400711	400883	401056	401228	173
252	401400	401573	401745	401917	402089	402261	402433	402605	402777	402949	172
253	403120	403292	403464	403635	403807	403978	404149	404320	404492	404663	171
254	404834	405005	405175	405346	405517	405688	405858	406029	406199	406370	171
255	406540	406710	406881	407051	407221	407391	407561	407731	407900	408070	170
256	408240	408410	408579	408749	408918	409087	409257	409426	409595	409764	169
257	409933	410102	410271	410440	410608	410777	410946	411114	411283	411451	169
258	411620	411788	411956	412124	412292	412460	412628	412796	412964	413132	168
259	413300	413467	413635	413802	413970	414137	414305	414472	414639	414806	167
260	414973	415140	415307	415474	415641	415808	415974	416141	416308	416474	167
261	416640	416807	416973	417139	417306	417472	417638	417804	417970	418135	166
262	418301	418467	418633	418798	418964	419129	419295	419460	419625	419791	165
263	419956	420121	420286	420451	420616	420781	420945	421110	421275	421439	165
264	421604	421768	421933	422097	422261	422426	422590	422754	422918	423082	164
265	423246	423410	423573	423737	423901	424064	424228	424392	424555	424718	164
266	424882	425045	425208	425371	425534	425697	425860	426023	426186	426349	163
267	426511	426674	426836	426999	427161	427324	427486	427648	427811	427973	162
268	428135	428297	428459	428621	428782	428944	429106	429268	429429	429591	162
269	429752	429914	430075	430236	430398	430559	430720	430881	431042	431203	161
270	431364	431525	431685	431846	432007	432167	432328	432488	432649	432809	160
271	432969	433129	433290	433450	433610	433770	433930	434090	434249	434409	160
272	434569	434728	434888	435048	435207	435366	435526	435685	435844	436003	159
273	436163	436322	436481	436640	436798	436957	437116	437275	437433	437592	159
274	437751	437909	438067	438226	438384	438542	438700	438859	439017	439175	158
275	439333	439491	439648	439806	439964	440122	440279	440437	440594	440752	158
276	440909	441066	441224	441381	441538	441695	441852	442009	442166	442323	157
277	442480	442636	442793	442950	443106	443263	443419	443576	443732	443888	157
278	444045	444201	444357	444513	444669	444825	444981	445137	445293	445448	156
279	445604	445760	445915	446071	446226	446382	446537	446692	446848	447003	155
	0	1	2	3	4	5	6	7	8	9	

TABLE 4.

Logarithms of Numbers.

No. 2800——3400 Log. 447158——531479

No.	0	1	2	3	4	5	6	7	8	9	Diff
280	447158	447313	447468	447623	447778	447933	448088	448242	448397	448552	155
281	448706	448861	449015	449170	449324	449478	449633	449787	449941	450095	154
282	450249	450403	450557	450711	450865	451018	451172	451326	451479	451633	154
283	451786	451940	452093	452247	452400	452553	452706	452859	453012	453165	153
284	453318	453471	453624	453777	453930	454082	454235	454387	454540	454692	153
285	454845	454997	455149	455302	455454	455606	455758	455910	456062	456214	152
286	456366	456518	456670	456821	456973	457125	457276	457428	457579	457730	152
287	457882	458033	458184	458336	458487	458638	458789	458940	459091	459242	151
288	459392	459543	459694	459845	459995	460146	460296	460447	460597	460747	151
289	460898	461048	461198	461348	461498	461649	461799	461948	462098	462248	150
290	462398	462548	462697	462847	462997	463146	463296	463445	463594	463744	150
291	463893	464042	464191	464340	464489	464639	464787	464936	465085	465234	149
292	465383	465532	465680	465829	465977	466126	466274	466423	466571	466719	149
293	466868	467016	467164	467312	467460	467608	467756	467904	468052	468200	148
294	468347	468495	468643	468790	468938	469085	469233	469380	469527	469675	148
295	469822	469969	470116	470263	470410	470557	470704	470851	470998	471145	147
296	471292	471438	471585	471732	471878	472025	472171	472317	472464	472610	147
297	472756	472903	473049	473195	473341	473487	473633	473779	473925	474070	146
298	474216	474362	474508	474653	474799	474944	475090	475235	475381	475526	146
299	475671	475816	475962	476107	476252	476397	476542	476687	476832	476976	145
300	477121	477266	477411	477555	477700	477844	477989	478133	478278	478422	145
301	478566	478711	478855	478999	479143	479287	479431	479575	479719	479863	144
302	480007	480151	480294	480438	480582	480725	480869	481012	481156	481299	144
303	481443	481586	481729	481872	482016	482159	482302	482445	482588	482731	143
304	482874	483016	483159	483302	483445	483587	483730	483872	484015	484157	143
305	484300	484442	484584	484727	484869	485011	485153	485295	485437	485579	142
306	485721	485863	486005	486147	486289	486430	486572	486714	486855	486997	142
307	487138	487280	487421	487563	487704	487845	487986	488127	488269	488410	141
308	488551	488692	488833	488973	489114	489255	489396	489537	489677	489818	141
309	489958	490099	490239	490380	490520	490661	490801	490941	491081	491222	140
310	491362	491502	491642	491782	491922	492062	492201	492341	492481	492621	140
311	492760	492900	493040	493179	493319	493458	493597	493737	493876	494015	139
312	494155	494294	494433	494572	494711	494850	494989	495128	495267	495406	139
313	495544	495683	495822	495960	496099	496237	496376	496514	496653	496791	139
314	496930	497068	497206	497344	497482	497621	497759	497897	498035	498173	138
315	498311	498448	498586	498724	498862	498999	499137	499275	499412	499550	138
316	499687	499824	499962	500099	500236	500374	500511	500648	500785	500922	137
317	501059	501196	501333	501470	501607	501744	501880	502017	502154	502290	137
318	502427	502564	502700	502837	502973	503109	503246	503382	503518	503654	136
319	503791	503927	504063	504199	504335	504471	504607	504743	504878	505014	136
320	505150	505286	505421	505557	505692	505828	505963	506099	506234	506370	136
321	506505	506640	506775	506911	507046	507181	507316	507451	507586	507721	135
322	507856	507991	508125	508260	508395	508530	508664	508799	508933	509068	135
323	509202	509337	509471	509606	509740	509874	510008	510143	510277	510411	134
324	510545	510679	510813	510947	511081	511215	511348	511482	511616	511750	134
325	511883	512017	512150	512284	512417	512551	512684	512818	512951	513084	133
326	513218	513351	513484	513617	513750	513883	514016	514149	514282	514415	133
327	514548	514680	514813	514946	515079	515211	515344	515476	515609	515741	133
328	515874	516006	516139	516271	516403	516535	516668	516800	516932	517064	132
329	517196	517328	517460	517592	517724	517855	517987	518119	518251	518382	132
330	518514	518645	518777	518909	519040	519171	519303	519434	519565	519697	131
331	519828	519959	520090	520221	520352	520483	520614	520745	520876	521007	131
332	521138	521269	521400	521530	521661	521792	521922	522053	522183	522314	131
333	522444	522575	522705	522835	522966	523096	523226	523356	523486	523616	130
334	523746	523876	524006	524136	524266	524396	524526	524656	524785	524915	130
335	525045	525174	525304	525434	525563	525693	525822	525951	526081	526210	129
336	526339	526468	526598	526727	526856	526985	527114	527243	527372	527501	129
337	527630	527759	527888	528016	528145	528274	528402	528531	528660	528788	129
338	528917	529045	529174	529302	529430	529559	529687	529815	529943	530072	128
339	530200	530328	530456	530584	530712	530840	530968	531095	531223	531351	128
	0	1	2	3	4	5	6	7	8	9	

Logarithms of Numbers.

No. 3400——4000 Log. 531479——602060

No.	0	1	2	3	4	5	6	7	8	9	Diff
340	531479	531607	531734	531862	531990	532117	532245	532372	532500	532627	128
341	532754	532882	533009	533136	533263	533391	533518	533645	533772	533899	127
342	534026	534153	534280	534407	534534	534661	534787	534914	535041	535167	127
343	535294	535421	535547	535674	535800	535927	536053	536179	536306	536432	126
344	536558	536685	536811	536937	537063	537189	537315	537441	537567	537693	126
345	537819	537945	538071	538197	538322	538448	538574	538699	538825	538951	126
346	539076	539202	539327	539452	539578	539703	539829	539954	540079	540204	125
347	540329	540455	540580	540705	540830	540955	541080	541205	541330	541454	125
348	541579	541704	541829	541953	542078	542203	542327	542452	542576	542701	125
349	542825	542950	543074	543199	543323	543447	543571	543696	543820	543944	124
350	544068	544192	544316	544440	544564	544688	544812	544936	545060	545183	124
351	545307	545431	545554	545678	545802	545925	546049	546172	546296	546419	124
352	546543	546666	546789	546913	547036	547159	547282	547405	547529	547652	123
353	547775	547898	548021	548144	548266	548389	548512	548635	548758	548881	123
354	549003	549126	549249	549371	549494	549616	549739	549861	549984	550106	123
355	550228	550351	550473	550595	550717	550840	550962	551084	551206	551328	122
356	551450	551572	551694	551816	551938	552059	552181	552303	552425	552546	122
357	552668	552790	552911	553033	553154	553276	553398	553519	553640	553762	121
358	553883	554004	554126	554247	554368	554489	554610	554731	554852	554973	121
359	555094	555215	555336	555457	555578	555699	555820	555940	556061	556182	121
360	556302	556423	556544	556664	556785	556905	557026	557146	557267	557387	120
361	557507	557627	557748	557868	557988	558108	558228	558348	558469	558589	120
362	558709	558829	558949	559068	559188	559308	559428	559548	559667	559787	120
363	559907	560026	560146	560265	560385	560504	560624	560743	560863	560982	119
364	561101	561221	561340	561459	561578	561698	561817	561936	562055	562174	119
365	562293	562412	562531	562650	562769	562887	563006	563125	563244	563362	119
366	563481	563600	563718	563837	563955	564074	564192	564311	564429	564548	119
367	564666	564784	564903	565021	565139	565257	565376	565494	565612	565730	118
368	565848	565966	566084	566202	566320	566437	566555	566673	566791	566909	118
369	567026	567144	567262	567379	567497	567614	567732	567849	567967	568084	118
370	568202	568319	568436	568554	568671	568788	568905	569023	569140	569257	117
371	569374	569491	569608	569725	569842	569959	570076	570193	570309	570426	117
372	570543	570660	570776	570893	571010	571126	571243	571359	571476	571592	117
373	571709	571825	571942	572058	572174	572291	572407	572523	572639	572755	116
374	572872	572988	573104	573220	573336	573452	573568	573684	573800	573915	116
375	574031	574147	574263	574379	574494	574610	574726	574841	574957	575072	116
376	575188	575303	575419	575534	575650	575765	575880	575996	576111	576226	115
377	576341	576457	576572	576687	576802	576917	577032	577147	577262	577377	115
378	577492	577607	577721	577836	577951	578066	578181	578295	578410	578525	115
379	578639	578754	578868	578983	579097	579212	579326	579441	579555	579669	114
380	579784	579898	580012	580126	580240	580355	580469	580583	580697	580811	114
381	580925	581039	581153	581267	581381	581495	581608	581733	581836	581950	114
382	582063	582177	582291	582404	582518	582631	582745	582858	582972	583085	114
383	583199	583312	583426	583539	583652	583765	583879	583992	584105	584218	113
384	584331	584444	584557	584670	584783	584896	585009	585122	585235	585348	113
385	585461	585574	585686	585799	585912	586024	586137	586250	586362	586475	113
386	586587	586700	586812	586925	587037	587149	587262	587374	587486	587599	112
387	587711	587823	587935	588047	588160	588272	588384	588496	588608	588720	112
388	588832	588944	589056	589167	589279	589391	589503	589615	589726	589838	112
389	589950	590061	590173	590284	590396	590507	590619	590730	590842	590953	112
390	591065	591176	591287	591399	591510	591621	591732	591843	591955	592066	111
391	592177	592288	592399	592510	592621	592732	592843	592954	593064	593175	111
392	593286	593397	593508	593618	593729	593840	593950	594061	594171	594282	111
393	594393	594503	594613	594724	594834	594945	595055	595165	595276	595386	110
394	595496	595606	595717	595827	595037	596047	596157	596267	596377	596487	110
395	596597	596707	596817	596927	597037	597146	597256	597366	597476	597585	110
396	597695	597805	597914	598024	598134	598243	598353	598462	598572	598681	110
397	598790	598900	599009	599119	599228	599337	599446	599556	599665	599774	109
398	599883	599992	600101	600210	600319	600428	600537	600646	600755	600864	109
399	600973	601082	601190	601299	601408	601517	601625	601734	601843	601951	109
	0	1	2	3	4	5	6	7	8	9	

TABLE 4.

Logarithms of Numbers.

No. 4000——4600   Log. 602060——662758

No.	0	1	2	3	4	5	6	7	8	9	Diff
400	602060	602169	602277	602386	602494	602603	602711	602819	602928	603036	108
401	603144	603253	603361	603469	603577	603686	603794	603902	604010	604118	108
402	604226	604334	604442	604550	604658	604766	604874	604982	605089	605197	108
403	605305	605413	605521	605628	605736	605844	605951	606059	606166	606274	108
404	606381	606489	606596	606704	606811	606919	607026	607133	607241	607348	107
405	607455	607562	607669	607777	607884	607991	608098	608205	608312	608419	107
406	608526	608633	608740	608847	608954	609061	609167	609274	609381	609488	107
407	609594	609701	609808	609914	610021	610128	610234	610341	610447	610554	107
408	610660	610767	610873	610979	611086	611192	611298	611405	611511	611617	106
409	611723	611829	611936	612042	612148	612254	612360	612466	612572	612678	106
410	612784	612890	612996	613101	613207	613313	613419	613525	613630	613736	106
411	613842	613947	614053	614159	614264	614370	614475	614581	614686	614792	106
412	614897	615003	615108	615213	615319	615424	615529	615634	615740	615845	105
413	615950	616055	616160	616265	616370	616475	616580	616685	616790	616895	105
414	617000	617105	617210	617315	617420	617524	617629	617734	617839	617943	105
415	618048	618153	618257	618262	618466	618571	618675	618780	618884	618989	105
416	619093	619198	619302	619406	619511	619615	619719	619823	619928	620032	104
417	620136	620240	620344	620448	620552	620656	620760	620864	620968	621072	104
418	621176	621280	621384	621488	621592	621695	621799	621903	622007	622110	104
419	622214	622318	622421	622525	622628	622732	622835	622939	623042	623146	104
420	623249	623353	623456	623559	623663	623766	623869	623972	624076	624179	103
421	624282	624385	624488	624591	624694	624798	624901	625004	625107	625209	103
422	625312	625415	625518	625621	625724	625827	625929	626032	626135	626238	103
423	626340	626443	626546	626648	626751	626853	626956	627058	627161	627263	103
424	627366	627468	627571	627673	627775	627878	627980	628082	628184	628287	102
425	628389	628491	628593	628695	628797	628900	629002	629104	629206	629308	102
426	629410	629511	629613	629715	629817	629919	630021	630123	630224	630326	102
427	630428	630530	630631	630733	630834	630936	631038	631139	631241	631342	102
428	631444	631545	631647	631748	631849	631951	632052	632153	632255	632356	101
429	632457	632558	632660	632761	632862	632963	633064	633165	633266	633367	101
430	633468	633569	633670	633771	633872	633973	634074	634175	634276	634376	101
431	634477	634578	634679	634779	634880	634981	635081	635182	635283	635383	101
432	635484	635584	635685	635785	635886	635986	636086	636187	636287	636388	100
433	636488	636588	636688	636789	636889	636989	637089	637189	637289	637390	100
434	637490	537590	637690	637790	637890	637990	638090	638190	638289	638389	100
435	638489	638589	638689	638789	638888	638988	639088	639188	639287	639387	100
436	639486	639586	639686	639785	639885	639984	640084	640183	640283	640382	99
437	640481	640581	640680	640779	640879	640978	641077	641176	641276	641375	99
438	641474	641573	641672	641771	641870	641970	642069	642168	642267	642366	99
439	642464	642563	642662	642761	642860	642959	643058	643156	643255	643354	99
440	643453	643551	643650	643749	643847	643946	644044	644143	644242	644340	98
441	644439	644537	644635	644734	644832	644931	645029	645127	645226	645324	98
442	645422	645520	645619	645717	645815	645913	646011	646109	646208	646306	98
443	646404	646502	646600	646698	646796	646894	646991	647089	647187	647285	98
444	647383	647481	647579	647676	647774	647872	647969	648067	648165	648262	98
445	648360	648458	648555	648653	648750	648848	648945	649043	649140	649237	97
446	649335	649432	649530	649627	649724	649821	649919	650016	650113	650210	97
447	650307	650405	650502	650599	650696	650793	650890	650987	651084	651181	97
448	651278	651375	651472	651569	651666	651762	651859	651956	652053	652150	97
449	652246	652343	652440	652536	652633	652730	652826	652923	653019	653116	97
450	653213	653309	653405	653502	653598	653695	653791	653888	653984	654080	96
451	654176	654273	654369	654465	654562	654658	654754	654850	654946	655042	96
452	655138	655234	655331	655427	655523	655619	655714	655810	655906	656002	96
453	656098	656194	656290	656386	656481	656577	656673	656769	656864	656960	96
454	657056	657151	657247	657343	657438	657534	657629	657725	657820	657916	96
455	658011	658107	658202	658298	658393	658488	658584	658679	658774	658870	95
456	658965	659060	659155	659250	659346	659441	659536	659631	659726	659821	95
457	659916	660011	660106	660201	660296	660391	660486	660581	660676	660771	95
458	660865	660960	661055	661150	661245	661339	661434	661529	661623	661718	95
459	661813	661907	662002	662096	662191	662285	662380	662474	662569	662663	95
	0	1	2	3	4	5	6	7	8	9	

TABLE 4.

Logarithms of Numbers.

No. 4600——5200 Log. 662758——716003 .

No.	0	1	2	3	4	5	6	7	8	9	Diff
460	662758	662852	662947	663041	663135	663230	663324	663418	663512	663607	94
461	663701	663795	663889	663983	664078	664172	664266	664360	664454	664548	94
462	664642	664736	664830	664924	665018	665112	665206	665299	665393	665487	94
463	665581	665675	665769	665862	665956	666050	666143	666237	666331	666424	94
464	666518	666612	666705	666799	666892	666986	667079	667173	667266	667359	94
465	667453	667546	667640	667733	667826	667920	668013	668106	668199	668293	93
466	668386	668479	668572	668665	668758	668852	668945	669038	669131	669224	93
467	669317	669410	669503	669596	669689	669782	669875	669967	670060	670153	93
468	670246	670339	670431	670524	670617	670710	670802	670895	670988	671080	93
469	671173	671265	671358	671451	671543	671636	671728	671821	671913	672005	93
470	672098	672190	672283	672375	672467	672560	672652	672744	672836	672929	92
471	673021	673113	673205	673297	673390	673482	673574	673666	673758	673850	92
472	673942	674034	674126	674218	674310	674402	674494	674586	674677	674769	92
473	674861	674953	675045	675136	675228	675320	675412	675503	675595	675687	92
474	675778	675870	675962	676053	676145	676236	676328	676419	676511	676602	92
475	676694	676785	676876	676968	677059	677151	677242	677333	677424	677516	91
476	677607	677698	677789	677881	677972	678063	678154	678245	678336	678427	91
477	678518	678609	678700	678791	678882	678973	679064	679155	679246	679337	91
478	679428	679519	679610	679700	679791	679882	679973	680063	680154	680245	91
479	680335	680426	680517	680607	680698	680789	680879	680970	681060	681151	91
480	681241	681332	681422	681513	681603	681693	681784	681874	681964	682055	90
481	682145	682235	682326	682416	682506	682596	682686	682777	682867	682957	90
482	683047	683137	683227	683317	683407	683497	683587	683677	683767	683857	90
483	683947	684037	684127	684217	684307	684396	684486	684576	684666	684756	90
484	684845	684935	685025	685114	685304	685294	685383	685473	685563	685652	90
485	685742	685831	685921	686010	686100	686189	686279	686368	686157	686547	89
486	686636	686726	686815	686904	686994	687083	687172	687261	687351	687440	89
487	687529	687618	687707	687796	687886	687975	688064	688153	688242	688331	89
488	688420	688509	688598	688687	688776	688865	688953	689042	689131	689220	89
489	689309	689398	689486	689575	689664	689753	689841	689930	690019	690107	89
490	690196	690285	690373	690462	690550	690639	690727	690816	690905	690993	89
491	691081	691170	691258	691347	691435	691524	691612	691700	691789	691877	88
492	691965	692053	692142	692230	692318	692406	692494	692583	692671	692759	88
493	692847	692935	693023	693111	693199	693287	693375	693463	693551	693639	88
494	693727	693815	693903	693991	694078	694166	694254	694342	694430	694517	88
495	694605	694693	694781	694868	694956	695044	695131	695219	695307	695394	88
496	695482	695569	695657	695744	695832	695919	696007	696094	696182	696269	87
497	696356	696444	696531	696618	696706	696793	696880	696968	697055	697142	87
498	697229	697317	697404	697491	697578	697665	697752	697839	697926	698013	87
499	698100	698188	698275	698362	698448	698535	698622	698709	698796	698883	87
500	698970	699057	699144	699231	699317	699404	699491	699578	699664	699751	87
501	699838	699924	700011	700098	700184	700271	700358	700444	700531	700617	87
502	700704	700790	700877	700963	701050	701136	701222	701309	701395	701482	86
503	701568	701654	701741	701827	701913	701999	702086	702172	702258	702344	86
504	702430	702517	702603	702689	702775	702861	702947	703033	703119	703205	86
505	703291	703377	703463	703549	703635	703721	703807	703893	703979	704065	86
506	704150	704236	704322	704408	704494	704579	704665	704751	704837	704922	86
507	705008	705094	705179	705265	705350	705436	705522	705607	705693	705778	86
508	705864	705949	706035	706120	706206	706291	706376	706462	706547	706632	85
509	706718	706803	706888	706974	707059	707144	707229	707315	707400	707485	85
510	707570	707655	707740	707826	707911	707996	708081	708166	708251	708336	85
511	708421	708506	708591	708676	708761	708846	708931	709015	709100	709185	85
512	709270	709355	709440	709524	709609	709694	709779	709863	709918	710033	85
513	710117	710202	710287	710371	710456	710540	710625	710710	710794	710879	85
514	710963	711048	711132	711216	711301	711385	711470	711554	711638	711723	84
515	711807	711892	711976	712060	712144	712229	712313	712397	712481	712566	84
516	712650	712734	712818	712902	712986	713070	713154	713238	713322	713406	84
517	713490	713574	713658	713742	713826	713910	713994	714078	714162	714246	84
518	714330	714414	714497	714581	714665	714749	714832	714916	715000	715084	84
519	715167	715251	715335	715418	715502	715586	715669	715753	715836	715920	84
	0	1	2	3	4	5	6	7	8	9	

TABLE 4.

Logarithms of Numbers.

No. 5200——5800 Log. 716003——763428

No.	0	1	2	3	4	5	6	7	8	9	Diff
520	716003	716087	716170	716254	716337	716421	716504	716588	716671	716754	83
521	716838	716921	717004	717088	717171	717254	717338	717421	717504	717587	83
522	717671	717754	717837	717920	718003	718086	718169	718253	718336	718419	83
523	718502	718585	718668	718751	718834	718917	719000	719083	719165	719248	83
524	719331	719414	719497	719580	719663	719745	719828	719911	719994	720077	83
525	720159	720242	720325	720407	720490	720573	720655	720738	720821	720903	83
526	720986	721068	721151	721233	721316	721398	721481	721563	721646	721728	82
527	721811	721893	721975	722058	722140	722222	722305	722387	722469	722552	82
528	722634	722716	722798	722881	722963	723045	723127	723209	723291	723374	82
529	723456	723538	723620	723702	723784	723866	723948	724030	724112	724194	82
530	724276	724358	724440	724522	724603	724685	724767	724849	724931	725013	82
531	725095	725176	725258	725340	725422	725503	725585	725667	725748	725830	82
532	725912	725993	726075	726156	726238	726320	726401	726483	726564	726646	82
533	726727	726809	726890	726972	727053	727134	727216	727297	727379	727460	81
534	727541	727623	727704	727785	727866	727948	728029	728110	728191	728273	81
535	728354	728435	728516	728597	728678	728759	728841	728922	729003	729084	81
536	729165	729246	729327	729408	729489	729570	729651	729732	729813	729893	81
537	729974	730055	730136	730217	730298	730378	730459	730540	730621	730702	81
538	730782	730863	730944	731024	731105	731186	731266	731347	731428	731508	81
539	731589	731669	731750	731830	731911	731991	732072	732152	732233	732313	81
540	732394	732474	732555	732635	732715	732796	732876	732956	733037	733117	80
541	733197	733278	733358	733438	733518	733598	733679	733759	733839	733919	80
542	733999	734079	734159	734240	734320	734400	734480	734560	734640	734720	80
543	734800	734880	734960	735040	735120	735200	735279	735359	735439	735519	80
544	735599	735679	735759	735838	735918	735998	736078	736157	736237	736317	80
545	736396	736476	736556	736635	736715	736795	736874	736954	737034	737113	80
546	737193	737272	737352	737431	737511	737590	737670	737749	737829	737908	79
547	737987	738067	738146	738225	738305	538384	738463	738543	738622	738701	79
548	738781	738860	738939	739018	739097	739177	739256	739335	739414	739493	79
549	739572	739651	739730	739810	739889	739968	740047	740126	740205	740284	79
550	740363	740442	740521	740599	740678	740757	740836	740915	740994	741073	79
551	741152	741230	741309	741388	741467	741546	741624	741703	741782	741860	79
552	741939	742018	742096	742175	742254	742332	742411	742489	742568	742647	79
553	742725	742804	742882	742961	743039	743118	743196	743275	743353	743431	78
554	743510	743588	743667	743745	743823	743902	743980	744058	744136	744215	78
555	744293	744371	744449	744528	744606	744684	744762	744840	744919	744997	78
556	745075	745153	745231	745309	745387	745465	745543	745621	745699	745777	78
557	745855	745933	746011	746089	746167	746245	746323	746401	746479	746556	78
558	746634	746712	746790	746868	746945	747023	747101	747179	747256	747334	78
559	747412	747489	747567	747645	747722	747800	747878	747955	748033	748110	78
560	748188	748266	748343	748421	748498	748576	748653	748731	748808	748885	77
561	748963	749040	749118	749195	749272	749350	749427	749504	749582	749659	77
562	749736	749814	749891	749968	750045	750123	750200	750277	750354	750431	77
563	750508	750586	750663	750740	750817	750894	750971	751048	751125	751202	77
564	751279	751356	751433	751510	751587	751664	751741	751818	751895	751972	77
565	752048	752125	752202	752279	752356	752433	752509	752586	752663	752740	77
566	752816	752893	752970	753047	753123	753200	753277	753353	753430	753506	77
567	753583	753660	753736	753813	753889	753966	754042	754119	754195	754272	77
568	754348	754425	754501	754578	754654	754730	754807	754883	754960	755036	76
569	755112	755189	755265	755341	755417	755494	755570	755646	755722	755799	76
570	755875	755951	756027	756103	756180	756256	756332	756408	756484	756560	76
571	756636	756712	756788	756864	756940	757016	757092	757168	757244	757320	76
572	757396	757472	757548	757624	757700	757775	757851	757927	758003	758079	76
573	758155	758230	758306	758382	758458	758533	758609	758685	758761	758836	76
574	758912	758988	759063	759139	759214	759290	759366	759441	759517	759592	76
575	759668	759743	759819	759894	759970	760045	760121	760196	760272	760347	75
576	760422	760498	760573	760649	760724	760799	760875	760950	761025	761101	75
577	761176	761251	761326	761402	761477	761552	761627	761702	761778	761853	75
578	761928	762003	762078	762153	762228	762303	762378	762453	762529	762604	75
579	762679	762754	762829	762904	762978	763053	763128	763203	763278	763353	75
	0	1	2	3	4	5	6	7	8	9	

TABLE 4.

Logarithms of Numbers.

No. 5800——6400 Log. 763428——806180

No.	0	1	2	3	4	5	6	7	8	9	Diff
580	763428	763503	763578	763653	763727	763802	763877	763952	764027	764101	75
581	764176	764251	764326	764400	764475	764550	764624	764699	764774	764848	75
582	764923	764998	765072	765147	765221	765296	765370	765445	765520	765594	75
583	765669	765743	765818	765892	765966	766041	766115	766190	766264	766338	74
584	766413	766487	766562	766636	766710	766785	766859	766933	767007	767082	74
585	767156	767230	767304	767379	767453	767527	767601	767675	767749	767823	74
586	767898	767972	768046	768120	768194	768268	768342	768416	768490	768564	74
587	768638	768712	768786	768860	768934	769008	769082	769156	769230	769303	74
588	769377	769451	769525	769599	769673	769746	769820	769894	769968	770042	74
589	770115	770189	770263	770336	770410	770484	770557	770631	770705	770778	74
590	770852	770926	770999	771073	771146	771220	771293	771367	771440	771514	74
591	771587	771661	771734	771808	771881	771955	772028	772102	772175	772248	73
592	772322	772395	772468	772542	772615	772688	772762	772835	772908	772981	73
593	773055	773128	773201	773274	773348	773421	773494	773567	773640	773713	73
594	773786	773860	773933	774006	774079	774152	774225	774298	774371	774444	73
595	774517	774590	774663	774736	774809	774882	774955	775028	775100	775173	73
596	775246	775319	775392	775465	775538	775610	775683	775756	775829	775902	73
597	775974	776047	776120	776193	776265	776338	776411	776483	776556	776629	73
598	776701	776774	776846	776919	776992	777064	777137	777209	777282	777354	73
599	777427	777499	777572	777644	777717	777789	777862	777934	778006	778079	73
600	778151	778224	778296	778368	778441	778513	778585	778658	778730	778802	72
601	778874	778947	779019	779091	779163	779236	779308	779380	779452	779524	72
602	779596	779669	779741	779813	779885	779957	780029	780101	780173	780245	72
603	780317	780389	780461	780533	780605	780677	780749	780821	780893	780965	72
604	781037	781109	781181	781253	781324	781396	781468	781540	781612	781684	72
605	781755	781827	781899	781971	782042	782114	782186	782258	782329	782401	72
606	782473	782544	782616	782688	782759	782831	782902	782974	783046	783117	72
607	783189	783260	783332	783403	783475	783546	783618	783689	783761	783832	71
608	783904	783975	784046	784118	784189	784261	784332	784403	784475	784546	71
609	784617	784689	784760	784831	784902	784974	785045	785116	785187	785259	71
610	785330	785401	785472	785543	785615	785686	785757	785828	785899	785970	71
611	786041	786112	786183	786254	786325	786396	786467	786538	786609	786680	71
612	786751	786822	786893	786964	787035	787106	787177	787248	787319	787390	71
613	787460	787531	787602	787673	787744	787815	787885	787956	788027	788098	71
614	788168	788239	788310	788381	788451	788522	788593	788663	788734	788804	71
615	788875	788946	789016	789087	789157	789228	789299	789369	789440	789510	71
616	789581	789651	789722	789792	789863	789933	790004	790074	790144	790215	70
617	790285	790356	790426	790496	790567	790637	790707	790778	790848	790918	70
618	790988	791059	791129	791199	791269	791340	791410	791480	791550	791620	70
619	791691	791761	791831	791901	791971	792041	792111	792181	792252	792322	70
620	792392	792462	792532	792602	792672	792742	792812	792882	792952	793022	70
621	793092	793162	793231	793301	793371	793441	793511	793581	793651	793721	70
622	793790	793860	793930	794000	794070	794139	794209	794279	794349	794418	70
623	794488	794558	794627	794697	794767	794836	794906	794976	795045	795115	70
624	795185	795254	795324	795393	795463	795532	795602	795671	795741	795811	69
625	795880	795949	796019	796088	796158	796227	796297	796366	796436	796505	69
626	796574	796644	796713	796782	796852	796921	796990	797060	797129	797198	69
627	797268	797337	797406	797475	797545	797614	797683	797752	797821	797890	69
628	797960	798029	798098	798167	798236	798305	798374	798443	798512	798582	69
629	798651	798720	798789	798858	798927	798996	799065	799134	799203	799272	69
630	799341	799409	799478	799547	799616	799685	799754	799823	799892	799961	69
631	800029	800098	800167	800236	800305	800373	800442	800511	800580	800648	69
632	800717	800786	800854	800923	800992	801060	801129	801198	801266	801335	69
633	801404	801472	801541	801609	801678	801747	801815	801884	801952	802021	69
634	802089	802158	802226	802295	802363	802432	802500	802568	802637	802705	68
635	802774	802842	802910	802979	803047	803116	803184	803252	803321	803389	68
636	803457	803525	803594	803662	803730	803798	803867	803935	804003	804071	68
637	804139	804208	804276	804344	804412	804480	804548	804616	804685	804753	68
638	804821	804889	804957	805025	805093	805161	805229	805297	805365	805433	68
639	805501	805569	805637	805705	805773	805841	805908	805976	806044	806112	68
	0	1	2	3	4	5	6	7	8	9	

TABLE 4.

Logarithms of Numbers.

No. 6400——7000 Log. 806180——845098

No.	0	1	2	3	4	5.	6	7	8	9	Diff
640	806180	806248	806316	806384	806451	806519	806587	806655	806723	806790	68
641	806858	806926	806994	807061	807129	807197	807264	807332	807400	807467	68
642	807535	807603	807670	807738	807806	807873	807941	808008	808076	808143	68
643	808211	808279	808346	808414	808481	808549	808616	808684	808751	808818	68
644	808886	808953	809021	809088	809156	809223	809290	809358	809425	809492	67
645	809560	809627	809694	809762	809829	809896	809964	810031	810098	810165	67
646	810233	810300	810367	810434	810501	810569	810636	810703	810770	810837	67
647	810904	810971	811038	811106	811173	811240	811307	811374	811441	811508	67
648	811575	811642	811709	811776	811843	811910	811977	812044	812111	812178	67
649	812245	812312	812378	812445	812512	812579	812646	812713	812780	812847	67
650	812913	812980	813047	813114	813181	813247	813314	813381	813448	813514	67
651	813581	813648	813714	813781	813848	813914	813981	814048	814114	814181	67
652	814248	814314	814381	814447	814514	814581	814647	814714	814780	814847	67
653	814913	814980	815046	815113	815179	815246	815312	815378	815445	815511	66
654	815578	815644	815711	815777	815843	815910	815976	816042	816109	816175	66
655	816241	816308	816374	816440	816506	816573	816639	816705	816771	816838	66
656	816904	816970	817036	817102	817169	817235	817301	817367	817433	817499	66
657	817565	817631	817698	817764	817830	817896	817962	818028	818094	818160	66
658	818226	818292	818358	818424	818490	818556	818622	818688	818754	818819	66
659	818885	818951	819017	819083	819149	819215	819281	819346	819412	819478	66
660	819544	819610	819675	819741	819807	819873	819939	820004	820070	820136	66
661	820201	820267	820333	820399	820464	820530	820595	820661	820727	820792	66
662	820858	820924	820989	821055	821120	821186	821251	821317	821382	821448	66
663	821514	821579	821644	821710	821775	821841	821906	821972	822037	822103	66
664	822168	822233	822299	822364	822430	822495	822560	822626	822691	822756	65
665	822822	822887	822952	823018	823083	823148	823213	823279	823344	823409	65
666	823474	823539	823605	823670	823735	823800	823865	823930	823996	824061	65
667	824126	824191	824256	824321	824386	824451	824516	824581	824646	824711	65
668	824776	824841	824906	824971	825036	825101	825166	825231	825296	825361	65
669	825426	825491	825556	825621	825686	825751	825815	825880	825945	826010	65
670	826075	826140	826204	826269	826334	826399	826464	826528	826593	826658	65
671	826723	826787	826852	826917	826981	827046	827111	827175	827240	827305	65
672	827369	827434	827498	827563	827628	827692	827757	827821	827886	827951	65
673	828015	828080	828144	828209	828273	828338	828402	828467	828531	828595	64
674	828660	828724	828789	828853	828918	828982	829046	829111	829175	829239	64
675	829304	829368	829432	829497	829561	829625	829690	829754	829818	829882	64
676	829947	830011	830075	830139	830204	830268	830332	830396	830460	830525	64
677	830589	830653	830717	830781	830845	830909	830973	831037	831102	831166	64
678	831230	831194	831358	831422	831486	831550	831614	831678	831742	831806	64
679	831870	831934	831998	832062	832126	832189	832253	832317	832381	832445	64
680	832509	832573	832637	832700	832764	832828	832892	832956	833020	833083	64
681	833147	833211	833275	833338	833402	833466	833530	833593	833657	833721	64
682	833784	833848	833912	833975	834039	834103	834166	834230	834293	834357	64
683	834421	834484	834548	834611	834675	834739	834802	834866	834929	834993	64
684	835056	835120	835183	835247	835310	835373	835437	835500	835564	835627	63
685	835691	835254	835817	835881	835944	836007	836071	836134	836197	836261	63
686	836324	836387	836451	836514	836577	836641	836704	836767	836830	836894	63
687	836957	837020	837083	837146	837210	837273	837336	837399	837462	837525	63
688	837588	837652	837715	837778	837841	837904	837967	838030	838093	838156	63
689	838219	838282	838345	838408	838471	838534	838597	838660	838723	838786	63
690	838849	838912	838975	839038	839101	839164	839227	839289	839352	839415	63
691	839478	839541	839604	839667	839729	839792	839855	839918	839981	840043	63
692	840106	840169	840232	840294	840357	840420	840482	840545	840608	840671	63
693	840733	840796	840859	840921	840984	841046	841109	841172	841234	841297	63
694	841359	841422	841485	841547	841610	841672	841735	841797	841860	841922	63
695	841985	842047	842110	842172	842235	842297	842360	842122	842484	842547	62
696	842609	842672	842734	842796	842859	842921	842983	843046	843108	843170	62
697	843233	843295	843357	843420	843482	843544	843606	843669	843731	843793	62
698	843855	843918	843980	844042	844104	844166	844229	844291	844353	844415	62
699	844477	844539	844601	844664	844726	844788	844850	844912	844974	845036	62
	0	1	2	3	4	5	6	7	8	9	

TABLE 4.

Logarithms of Numbers.

No. 7000——7600 Log. 845098—— 880814

No.	0	1	2	3	4	5	6	7	8	9	Diff
700	845098	845160	845222	845284	845346	845408	845470	845532	845594	845656	62
701	845718	845780	845842	845904	845966	846028	846090	846151	846213	846275	62
702	846337	846399	846461	846523	846584	846646	846708	846770	846832	846894	62
703	846955	847017	847079	847141	847202	847264	847326	847388	847449	847511	62
704	847573	847634	847696	847758	847819	847881	847943	848004	848066	848127	62
705	848189	848251	848312	848374	848435	848497	848559	848620	848682	848743	62
706	848805	848866	848928	848989	849051	849112	849174	849235	849296	849358	61
707	849419	849481	849542	849604	849665	849726	849788	849849	849911	849972	61
708	850033	850095	850156	850217	850279	850340	850401	850462	850524	850585	61
709	850646	850707	850769	850830	850891	850952	851014	851075	851136	851197	61
710	851258	851320	851381	851442	851503	851564	851625	851686	851747	851808	61
711	851870	851931	851992	852053	852114	852175	852236	852297	852358	852419	61
712	852480	852541	852602	852663	852724	852785	852846	852907	852968	853029	61
713	853090	853150	853211	853272	853333	853394	853455	853516	853576	853637	61
714	853698	853759	853820	853881	853941	854002	854063	854124	854185	854245	61
715	854306	854367	854427	854488	854549	854610	854670	854731	854792	854852	61
716	854913	854974	855034	855095	855156	855216	855277	855337	855398	855459	61
717	855519	855580	855640	855701	855761	855822	855882	855943	856003	856064	61
718	856124	856185	856245	856306	856366	856427	856487	856548	856608	856668	60
719	856729	856789	856850	856910	856970	857031	857091	857151	857212	857272	60
720	857332	857393	857453	857513	857574	857634	857694	857754	857815	857875	60
721	857935	857995	858056	858116	858176	858236	858297	858357	858417	858477	60
722	858537	858597	858657	858718	858778	858838	858898	858958	859018	859078	60
723	859138	859198	859258	859318	859378	859438	859499	859559	859619	859679	60
724	859739	859799	859858	859918	859978	860038	860098	860158	860218	860378	60
725	860338	860398	860458	860518	860578	860637	860697	860757	860817	860877	60
726	860937	860996	861056	861116	861176	861236	861295	861355	861415	861475	60
727	861534	861594	861654	861714	861773	861833	861893	861952	862012	862072	60
728	862131	862191	862251	862310	862370	862430	862489	862549	862608	862668	60
729	862728	862787	862847	862906	862966	863025	863085	863144	863204	863263	60
730	863323	863382	863442	863591	863501	863620	863680	863739	863798	863858	59
731	863917	863977	864036	864096	864155	864214	864274	864333	864392	864452	59
732	864511	864570	864630	864689	864748	864808	864867	864926	864985	865045	59
733	865104	865163	865222	865282	865341	865400	865459	865518	865578	865637	59
734	865696	865755	865814	865874	865933	865992	866051	866110	866169	866228	59
735	866287	866346	866405	866465	866524	866583	866642	866701	866760	866819	59
736	866878	866937	866996	867055	867114	867173	867232	867291	867350	867409	59
737	867467	867526	867585	867644	867703	867762	867821	867880	867939	867998	59
738	868056	868115	868174	868233	868292	868350	868409	868468	868527	868586	59
739	868644	868703	868762	868821	868879	868938	868997	869056	869114	869173	59
740	869232	869290	869349	869408	869466	869525	869584	869642	869701	869760	59
741	869818	869877	869935	869994	870053	870111	870170	870228	870287	870345	59
742	870404	870462	870521	870579	870638	870696	870755	870813	870872	870930	58
743	870989	871047	871106	871164	871223	871281	871339	871398	871456	871515	58
744	871573	871631	871690	871748	871806	871865	871923	871981	872040	872098	58
745	872156	872215	872273	872331	872389	872448	872506	872564	872622	872681	58
746	872739	872797	872855	872913	872972	873030	873088	873146	873204	373262	58
747	873321	873379	873437	873495	873553	873611	873669	873727	873785	873844	58
748	873902	873960	874018	874076	874134	874192	874250	874308	874366	874424	58
749	874482	874540	874598	874656	874714	874772	874830	874887	874945	875003	58
750	875061	875119	875177	875235	875293	875351	875409	875466	875524	875582	58
751	875640	875698	875756	875813	875871	875929	875987	876045	876102	876160	58
752	876218	876276	876333	876391	876449	876507	876564	876622	876680	876737	58
753	876795	876853	876910	876968	877026	877083	877141	877198	877256	877314	58
754	877371	877429	877486	877544	877602	877659	877717	877774	877832	877889	58
755	877947	878004	878062	878119	878177	878234	878292	878349	878407	878464	57
756	878522	878579	878637	878694	878751	878809	878866	878924	878981	879038	57
757	879096	879153	879211	879268	879325	879383	879440	879497	879555	879612	57
758	879669	879726	879784	879841	879898	879956	880013	880070	880127	880185	57
759	880242	880299	880356	880413	880471	880528	880585	880642	880699	880756	57
	0	1	2	3	4	5	6	7	8	9	

TABLE 4.

Logarithms of Numbers.

No. 7600 —— 8200   Log. 880814 ——913814

No.	0	1	2	3	4	5	6	7	8	9	Diff
760	880814	880871	880928	880985	881042	881099	881156	881213	881270	881328	57
761	881385	881442	881499	881556	881613	881670	881727	881784	881841	881898	57
762	881955	882012	882069	882126	882183	882240	882297	882354	882411	882468	57
763	882524	882581	882638	882695	882752	882809	882866	882923	882980	883037	57
764	883093	883150	883207	883264	883321	883377	883434	883491	883548	883605	57
765	883661	883718	883775	883832	883888	883945	884002	884059	884115	884172	57
766	884229	884285	884342	884399	884455	884512	884569	884625	884682	884739	57
767	884795	884852	884909	884965	885022	885078	885135	885192	885248	885305	57
768	885361	885418	885474	885531	885587	885644	885700	885757	885813	885870	57
769	885926	885983	886039	886096	886152	886209	886265	886321	886378	886434	56
770	886491	886547	886604	886660	886716	886773	886829	886885	886942	886998	56
771	887054	887111	887167	887223	887280	887336	887392	887449	887505	887561	56
772	887617	887674	887730	887786	887842	887898	887955	888011	888067	888123	56
773	888179	888236	888292	888348	888404	888460	888516	888573	888629	888685	56
774	888741	888797	888853	888909	888965	889021	889077	889134	889190	889246	56
775	889302	889358	889414	889470	889526	889582	889638	889694	889750	889806	56
776	889862	889918	889974	890030	890086	890141	890197	890253	890309	890365	56
777	890421	890477	890533	890589	890644	890700	890756	890812	890868	890924	56
778	890980	891035	891091	891147	891203	891259	891314	891370	891426	891482	56
779	891537	891593	891649	891705	891760	891816	891872	891928	891983	892039	56
780	892095	892150	892206	892262	892317	892373	892429	892484	892540	892595	56
781	892651	892707	892762	892818	892873	892929	892985	803040	893096	893151	56
782	893207	893262	893318	893373	893429	893484	893540	893595	893651	893706	56
783	893762	893817	893873	893928	893984	894039	894094	894150	894205	894261	55
784	894316	894371	894427	894482	894538	894593	894648	894704	894759	894814	55
785	894870	894925	894980	895036	895091	895146	895201	895257	895312	895367	55
786	895423	895478	895533	895588	895643	895699	895754	895809	895864	895920	55
787	895975	896030	896085	896140	896195	896251	896306	896361	896416	896471	55
788	896526	896581	896636	896692	896747	896802	896857	896912	896967	897022	55
789	897077	897132	897187	897242	897297	897352	897407	897462	897517	897572	55
790	897627	897682	897737	897792	897847	897902	897957	898012	898067	898122	55
791	898176	898231	898286	898341	898396	898451	898506	898561	898615	898670	55
792	898725	898780	898835	898890	898944	898999	899054	899109	899164	899218	55
793	899273	899328	899383	899437	899492	899547	899602	899656	899711	899766	55
794	899820	899875	899930	899985	900039	900094	900149	900203	900258	900312	55
795	900367	900422	900476	900531	900586	900640	900695	900749	900804	900858	55
796	900913	900968	901022	901077	901131	901186	901240	901295	901349	901404	55
797	901458	901513	901567	901622	901676	901731	901785	901840	901894	901948	54
798	902003	902057	902112	902166	902221	902275	902329	902384	902438	902491	54
799	902547	902601	902655	902710	902764	902818	902873	902927	902981	903036	54
800	903090	903144	903198	903253	903307	903361	903416	903470	903524	903578	54
801	903632	903687	903741	903795	903849	903903	903958	904012	904066	904120	54
802	904174	904228	904283	904337	904391	904445	904499	904553	904607	904661	54
803	904715	904770	904824	904878	904932	904986	905040	905094	905148	905202	54
804	905256	905310	905364	905418	905472	905526	905580	905634	905688	905742	54
805	905796	905850	905904	905958	906012	906065	906119	906173	906227	906281	54
806	906335	906389	906443	906497	906550	906604	906658	906712	906766	906820	54
807	906873	906927	906981	907035	907089	907142	907196	907250	907304	907358	54
808	907411	907465	907519	907573	907626	907680	907734	907787	907841	907895	54
809	907948	908002	908056	908109	908163	908217	908270	908324	908378	908431	54
810	908485	908539	908592	908646	908699	908753	908807	908860	908914	908967	54
811	909021	909074	909128	909181	909235	909288	909342	909395	909449	909502	54
812	909556	909609	909663	909716	909770	909823	909877	909930	609984	910037	53
813	910090	910144	910197	910251	910304	910358	910411	910464	910518	610571	53
814	910624	910678	910731	910784	910838	910891	910944	910998	911051	911104	53
815	911158	911211	911264	911317	911371	911424	911477	911530	911584	911637	53
816	911690	911743	911797	911850	911903	911956	912009	912063	912116	912169	53
817	912222	912275	912328	912381	912435	912488	912541	912594	912647	912700	53
818	912753	912806	912859	912913	912966	913019	913072	913125	913178	913231	53
819	913284	913337	913390	913443	913496	913549	913602	913655	913708	913761	53
	0	1	2	3	4	5	6	7	8	9	

Logarithms of Numbers.

No. 8200——8800 Log. 913814——944483

No.	0	1	2	3	4	5	6	7	8	9	Diff
820	913814	913867	913920	913973	914026	914079	914131	914184	914237	914290	53
821	914343	914396	914449	914502	914555	914608	914660	914713	914766	914819	53
822	914872	914925	914977	915030	915083	915136	915189	915241	915294	915347	53
823	915400	915453	915505	915558	915611	915664	915716	915769	915822	915874	53
824	915927	915980	916033	916085	916138	916191	916243	916296	916349	916401	53
825	916454	916507	916559	916612	916664	916717	916770	916822	916875	916927	53
826	916980	917033	917085	917138	917190	917243	917295	917348	917400	917453	53
827	917505	917558	917610	917663	917715	917768	917820	917873	917925	917978	52
828	918030	918083	918135	918188	918240	918292	918345	918397	918450	918502	52
829	918555	918607	918659	918712	918764	918816	918869	918921	918973	919026	52
830	919078	919130	919183	919235	919287	919340	919392	919444	919496	919549	52
831	919601	919653	919705	919758	919810	919862	919914	919967	920019	920071	52
832	920123	920175	920228	920280	920332	920384	920436	920489	920541	920593	52
833	920645	920697	920749	920801	920853	920906	920958	921010	921062	921114	52
834	921166	921218	921270	921322	921374	921426	921478	921530	921582	921634	52
835	921686	921738	921790	921842	921894	921946	921998	922050	922102	922154	52
836	922206	922258	922310	922362	922414	922466	922518	922570	922622	922674	52
837	922725	922777	922829	922881	922933	922985	923037	923088	923140	923192	52
838	923244	923296	923348	923399	923451	923503	923555	923607	923658	923710	52
839	923762	923814	923865	923917	923696	924021	924072	924124	924176	924228	52
840	924279	924331	924383	924434	924486	924538	924589	924641	924693	924744	52
841	924796	924848	924899	924951	925002	925054	925106	925157	925209	925260	52
842	925312	925364	925414	925467	925518	925570	925621	925673	925724	925776	52
843	925828	925879	925931	925982	926034	926085	926137	926188	926239	926291	51
844	926342	926394	926445	926497	926548	926600	926651	926702	926754	926805	51
845	926857	926908	926959	927011	927062	927114	927165	927216	927268	927319	51
846	927370	927423	927473	927524	927576	927627	927678	927730	927781	927832	51
847	927883	927935	927986	928037	928088	928140	928191	928242	928293	928345	51
848	928396	928447	928498	928549	928601	928652	928703	928754	928805	928856	51
849	928908	928959	929010	929061	929112	929163	929214	929266	929317	929368	51
850	929419	929470	929521	929572	929623	929674	929725	929776	929827	929878	51
851	929930	929981	930032	930083	930134	930185	930236	930287	930338	930389	51
852	930440	930491	930541	930592	930643	930694	930745	930796	930847	930898	51
853	930949	931000	931051	931102	931153	931203	931254	931305	931356	931407	51
854	931458	931509	931560	931610	931661	931712	931763	931814	931864	931915	51
855	931966	932017	932068	932118	932169	932220	932271	932321	932372	932423	51
856	932474	932524	932575	932626	932677	932727	932778	932829	932879	932930	51
857	932981	933031	933082	933133	933183	933234	933285	933335	933386	933437	51
858	933487	933538	933588	933639	933690	933740	933791	933841	933892	933943	51
859	933993	934044	934094	934145	934195	934246	934296	934347	934397	934448	51
860	934498	934549	934599	934650	934700	934751	934801	934852	934902	934953	50
861	935003	935054	935104	935154	935205	935255	935306	935356	935406	935457	50
862	935507	935558	935608	935658	935709	935759	935809	935860	935910	935960	50
863	936011	936061	936111	936162	936212	936262	936313	936363	936413	936463	50
864	936514	936564	936614	936664	936715	936765	936815	936865	936916	936966	50
865	937016	937066	937116	937167	937217	937267	937317	937367	937418	937468	50
866	937518	937568	937618	937668	937718	937769	937819	937869	937919	937969	50
867	938019	938069	938119	938169	938219	938269	938319	938370	938420	938470	50
868	938520	938570	938620	938670	938720	938770	938820	938870	938920	938970	50
869	939020	939070	939120	939170	939220	939270	939319	939369	939419	939469	50
870	939519	939569	939619	939669	939719	939769	939819	939868	939918	939968	50
871	940018	940068	940118	940168	940218	940267	940317	940367	940417	940467	50
872	940516	940566	940616	940666	940716	940765	940815	940865	940915	940964	50
873	941014	941064	941114	941163	941213	941263	941313	941362	941412	941462	50
874	941511	941561	941611	941660	941710	941760	941809	941859	941909	941958	50
875	942008	942058	942107	942157	942206	942256	942306	942355	942405	942454	50
876	942504	942554	942603	942653	942702	942752	942801	942851	942900	942950	50
877	943000	943049	943099	943148	943198	943247	943297	943346	943396	943445	49
878	943494	943544	943593	943643	943692	943742	943791	943841	943890	943939	49
879	943989	944038	944088	944137	944186	944236	944285	944335	944384	944433	49
	0	1	2	3	4	5	6	7	8	9	

TABLE 4.

Logarithms of Numbers.

No. 8800 ——9400 Log. 944483——973128

No.	0	1	2	3	4	5	6	7	8	9	Diff
880	944483	944532	944581	944631	944680	944729	944779	944828	944877	944927	49
881	944976	945025	945074	945124	945173	945222	945272	945321	945370	945419	49
882	945469	945518	945567	945616	945665	945715	945764	945813	945862	945911	49
883	945961	946010	946059	946108	946157	946207	946256	946305	946354	946403	49
884	946452	946501	946550	946600	946649	946698	946747	946796	946845	946894	49
885	946943	946992	947041	947090	947139	947189	947238	947287	947336	947385	49
886	947434	947483	947532	947581	947630	947679	947728	947777	947826	947875	49
887	947924	947973	948021	948070	948119	948168	948217	948266	948315	948364	49
888	948413	948462	948511	948560	948608	948657	948706	948755	948804	948853	49
889	948902	948951	948999	949048	949097	949146	949195	949244	949292	949341	49
890	949390	949439	949488	949536	949585	949634	949683	949731	949780	949829	49
891	949878	949926	949975	950024	950073	950121	950170	950219	950267	950316	49
892	950365	950413	950462	950511	950560	950608	950657	950705	950754	950803	49
893	950851	950900	950949	950997	951046	951095	951143	951192	951240	951289	49
894	951337	951386	951435	951483	951532	951580	951629	951677	951726	951774	49
895	951823	951872	951920	951969	952017	952066	952114	952163	952211	952259	48
896	952308	952356	952405	952453	952502	952550	952599	952647	952696	952744	48
897	952792	952841	952889	952938	952986	953034	953083	953131	953180	953228	48
898	953276	953325	953373	953421	953470	953518	953566	953615	953663	953711	48
899	953760	953808	953856	953905	953953	954001	954049	954098	954146	954194	48
900	954242	954291	954339	954387	954435	954484	954532	954580	954628	954677	48
901	954725	954773	954821	954869	954918	954966	955014	955062	955110	955158	48
902	955206	955255	955303	955351	955399	955447	955495	955543	955592	955640	48
903	955688	955736	855784	955832	955880	955928	955976	956024	956072	956120	48
904	956168	956216	956264	956312	956361	956409	956457	956505	956553	956601	48
905	956649	956697	956745	956792	956840	956888	956936	956984	957032	957080	48
906	957128	957176	957224	957272	957320	957368	957416	957464	957511	957559	48
907	957607	957655	957703	957751	957799	957847	957894	957942	957990	958038	48
908	958086	958134	958181	958229	958277	958325	958373	958420	958468	958516	48
909	958564	958612	958659	958707	958755	958803	958850	958898	958946	958994	48
910	959041	959089	959137	959184	959232	959280	959328	959375	959423	959471	48
911	959518	959566	959614	959661	959709	959757	959804	959852	959900	959947	48
912	959995	960042	960090	960138	960185	960233	960281	960328	960376	960423	48
913	960471	960518	960566	960613	960661	960709	960756	960804	960851	960899	48
914	960946	960994	961041	961089	961136	961184	961231	961279	961326	961374	48
915	961421	961469	961516	961563	961611	961658	961706	961753	961801	961848	47
916	961895	961943	961990	962038	962085	962132	962180	962227	962275	962322	47
917	962369	962417	962464	962511	962559	962606	962653	962701	962748	962795	47
918	962843	962890	962937	962985	963032	963079	963126	963174	963221	963268	47
919	963315	963363	963410	963457	963504	963552	963599	963646	963693	963741	47
920	963788	963835	963882	963929	963977	964024	964071	964118	964165	964212	47
921	964260	964307	964354	964401	964448	964495	964542	964590	964637	964684	47
922	964731	964778	964825	964872	964919	964966	965013	965060	965108	965155	47
923	965202	965249	965296	965343	965390	965437	965484	965531	965578	965625	47
924	965672	965719	965766	965813	965860	965907	965954	966001	966048	966095	47
925	966142	966189	966236	966283	966329	966376	966423	966470	966517	966564	47
926	966611	966658	966705	966752	966798	966845	966892	966939	966986	967033	47
927	967080	967127	967173	967220	967267	967314	967361	987408	967454	967501	47
928	967548	967595	967642	967688	967735	967782	967829	967875	967922	967969	47
929	968016	968062	968109	968156	968203	968249	968296	968343	968389	968436	47
930	968483	968530	968576	968623	968670	968716	968763	968810	968856	968903	47
931	968950	968996	969043	969090	969136	969183	969229	969276	969323	969369	47
932	969416	969462	969509	969556	969602	969649	969695	969742	969788	969835	47
933	969882	969928	969975	970021	970068	970114	970161	970207	970254	970300	47
934	970347	970393	970440	970486	970533	970579	970626	970672	970719	970765	47
935	970812	970858	970904	970951	970997	971044	971090	971137	971183	971229	46
936	971276	971322	971369	971415	971461	971508	971554	971600	971647	971693	46
937	971740	971786	971832	971879	971925	971971	972018	972064	972110	972156	46
938	972203	972249	972295	972342	972388	972434	972480	972527	972573	972619	46
939	972666	972712	972758	972804	972851	972897	972943	972989	973035	973082	46
	0	1	2	3	4	5	6	7	8	9	

TABLE 4.

Logarithms of Numbers.

No. 9400——10000 Log. 973128——000000

No	0	1	2	3	4	5	6	7	8	9	Diff
940	973128	973174	973220	973266	973313	973359	973405	973451	973497	973543	46
941	973590	973636	973682	973728	973774	973820	973866	973913	973959	974005	46
942	974051	974097	974143	974189	974235	974281	974327	974373	974420	974466	46
943	974512	974558	974604	974650	974696	974742	974788	974834	974880	974926	46
944	974972	975018	975064	975110	975156	975202	975248	975294	975340	975386	46
945	975432	975478	975524	975570	975616	975661	975707	975753	975799	975845	46
946	975891	975937	975983	976029	976075	976121	976166	976212	976258	976304	46
947	976350	976396	976442	976487	976533	976579	976625	976671	976717	976762	46
948	976808	976854	976900	976946	976991	977037	977083	977129	977175	977220	46
949	977266	977312	977358	977403	977449	977495	977541	977586	977632	977678	46
950	977724	977769	977815	977861	977906	977952	977998	978043	978089	978135	46
951	978180	978226	978272	978317	978363	978409	978454	978500	978546	978591	46
952	978637	978683	978728	978774	978819	978865	978911	978956	979002	979047	46
953	979093	979138	979184	979230	979275	979321	979366	979412	979457	979503	46
954	979548	979594	979639	979685	979730	979776	979821	979867	979912	979958	46
955	980003	980049	980094	980140	980185	980231	980276	980322	980367	980412	45
956	980458	980503	980549	980594	980640	980685	980730	980776	980821	980867	45
957	980912	980957	981003	981048	981093	981139	981184	981229	981275	981320	45
958	981365	981411	981456	981501	981547	981592	981637	981683	981728	981773	45
959	981819	981864	981909	981954	982000	982045	982090	982135	982181	982226	45
960	982271	982316	982362	982407	982452	982497	982543	982588	982633	982678	45
961	982723	982769	982814	982859	982904	982949	982994	983040	983085	983130	45
962	983175	983220	983265	983310	983356	983401	983446	983491	983536	983581	45
963	983626	983671	983716	983762	983807	983852	983897	983942	983987	984032	45
964	984077	984122	984167	984212	984257	984302	984347	984392	984437	984482	45
965	984527	984572	984617	984662	984707	984752	984797	984842	984887	984932	45
966	984977	985022	985067	985112	985157	985202	985247	985292	985337	985382	45
967	985426	985471	985516	985561	985606	985651	985696	985741	985786	985830	45
968	985875	985920	985965	986010	986055	986100	986144	986189	986234	986279	45
969	986324	986369	986413	986458	986503	986548	986593	986637	986682	986727	45
970	986772	986816	986861	986906	986951	986995	987040	987085	987130	987174	45
971	987219	987264	987309	987353	987398	987443	987487	987532	987577	987622	45
972	987666	987711	987756	987800	987845	987890	987934	987979	988024	988068	45
973	988113	988157	988202	988247	988291	988336	988381	988425	988470	988514	45
974	988559	988603	988648	988693	988737	988782	988826	988871	988915	988960	45
975	989005	989049	989094	989138	989183	989227	989272	989316	989361	989405	45
976	989450	989494	989539	989583	989628	989672	989717	989761	989806	989850	44
977	989895	989939	989983	990028	990076	990117	990161	990206	990250	990294	44
978	990339	990383	990428	990472	990516	990561	990605	990650	990694	990738	44
979	990783	990827	990871	990916	990960	991004	991049	991093	991137	991182	44
980	991226	991270	991315	991359	991403	991448	991492	991536	991580	991625	44
981	991669	991713	991757	991802	991846	991890	991934	991979	992023	992067	44
982	992111	992156	992200	992244	992288	992333	992377	992421	992465	992509	44
983	992553	992598	992642	992686	992730	992774	992818	992863	992907	992951	44
984	992995	993039	993083	993127	993172	993216	993260	993304	993348	993392	44
985	993436	993480	993524	993568	993613	993657	993701	993745	993789	993833	44
986	993877	993921	993965	994009	994053	994097	994141	994185	994229	994273	44
987	994317	994361	994405	994449	994493	994537	994581	994625	994669	994713	44
988	994757	994801	994845	994889	994933	994977	995021	995064	995108	995152	44
989	995196	995240	895284	995328	995372	995416	995460	995504	995547	995591	44
990	995635	995679	995723	995767	995811	995854	995898	995942	995986	996030	44
991	996074	996117	996161	996205	996249	996293	996336	996380	996424	996468	44
992	996512	996555	996599	996643	996687	996730	996774	996818	996862	996905	44
993	996949	996993	997037	997080	997124	997168	997212	997255	997299	997343	44
994	997386	997430	997474	997517	997561	997605	997648	997692	997736	997779	44
995	997823	997867	997910	997954	997998	998041	998085	998128	998172	998216	44
996	998259	998303	998346	998390	998434	998477	998521	998564	998608	998652	44
997	998695	998739	998782	998826	998869	998913	998956	999000	999043	999087	44
998	999130	999174	999218	999261	999305	999348	999392	999435	999478	999522	44
999	999565	999609	999652	999696	999739	999783	999826	999870	999913	999957	43
	0	1	2	3	4	5	6	7	8	9	

TABLE 5.

Logarithmic Sines.

Sine 0 Degree.

′	0″	10″	20″	30″	40″	50″		Diff.
0		5·685575	5·986605	6·162696	6·287635	6·384545	59	
1	6·463726	6·530673	6·588665	6·639817	6·685575	6·726967	58	
2	6·764756	6·799518	6·831703	6·861666	6·889695	6·916024	57	
3	6·940847	6·964328	6·986605	7·007794	7·027997	7·047303	56	
4	7·065786	7·083515	7·100548	7·116938	7·132733	7·147973	55	
5	7·162696	7·176936	7·190725	7·204089	7·217054	7·229643	54	
6	7·241877	7·253776	7·265358	7·276639	7·287635	7·298358	53	
7	7·308824	7·319043	7·329027	7·338787	7·348332	7·357672	52	
8	7·366816	7·375770	7·384544	7·393145	7·401578	7·409850	51	
9	7·417968	7·425937	7·433762	7·441449	7·449002	7·456426	50	
10	7·463725	7·470904	7·477966	7·484915	7·491754	7·498487	49	6894
11	7·505118	7·511649	7·518083	7·524423	7·530672	7·536832	48	6294
12	7·542906	7·548897	7·554806	7·560635	7·566387	7·572065	47	5791
13	7·577668	7·583201	7·588664	7·594059	7·599388	7·604652	46	5362
14	7·609853	7·614993	7·620072	7·625093	7·630056	7·634963	45	4992
15	7·639816	7·644615	7·649361	7·654056	7·658701	7·663297	44	4670
16	7·667844	7·672345	7·676799	7·681208	7·685573	7·689894	43	4387
17	7·694173	7·698410	7·702606	7·706762	7·710879	7·714957	42	4136
18	7·718997	7·722999	7·726965	7·730896	7·734791	7·738651	41	3913
19	7·742477	7·746270	7·750031	7·753758	7·757454	7·761119	40	3712
20	7·764754	7·768358	7·771932	7·775477	7·778994	7·782482	39	3531
21	7·785943	7·789376	7·792782	7·796162	7·799515	7·802843	38	3366
22	7·806146	7·809423	7·812677	7·815905	7·819111	7·822292	37	3217
23	7·825451	7·828586	7·831700	7·834791	7·837860	7·840907	36	3030
24	7·843934	7·846939	7·849924	7·852888	7·855833	7·858757	35	2954
25	7·861662	7·864548	7·867414	7·870262	7·873092	7·875902	34	2838
26	7·878695	7·881470	7·884228	7·886968	7·889690	7·892396	33	2731
27	7·895085	7·897758	7·900414	7·903054	7·905678	7·908287	32	2632
28	7·910879	7·913457	7·916019	7·918566	7·921098	7·923616	31	2540
29	7·926119	7·928608	7·931082	7·933543	7·935989	7·938422	30	2453
30	7·940842	7·943248	7·945641	7·948020	7·950387	7·952741	29	2373
31	7·955082	7·957410	7·959727	7·962031	7·964322	7·966602	28	2297
32	7·968870	7·971126	7·973370	7·975603	7·977824	7·980034	27	2227
33	7·982233	7·984421	7·986598	7·988764	7·990919	7·993064	26	2161
34	7·995198	7·997322	7·999435	8·001538	8·003631	8·005714	25	2098
35	8·007787	8·009850	8·011903	8·013947	8·015981	8·018005	24	2039
36	8·020021	8·022027	8·024023	8·026011	8·027989	8·029959	23	1983
37	8·031919	8·033871	8·035814	8·037749	8·039675	8·041592	22	1930
38	8·043501	8·045401	8·047294	8·049178	8·051054	8·052922	21	1880
39	8·054781	8·056633	8·058477	8·060314	8·062142	8·063963	20	1832
40	8·065776	8·067582	8·069380	8·071171	8·072955	8·074731	19	1787
41	8·076500	8·078261	8·080016	8·081764	8·083504	8·085238	18	1744
42	8·086965	8·088684	8·090398	8·092104	8·093804	8·095497	17	1703
43	8·097183	8·098863	8·100537	8·102204	8·103864	8·105519	16	1664
44	8·107167	8·108809	8·110444	8·112074	8·113697	8·115315	15	1626
45	8·116926	8·118532	8·120131	8·121725	8·123313	8·124895	14	1590
46	8·126471	8·128042	8·129606	8·131166	8·132720	8·134568	13	1556
47	8·135810	8·137348	8·138879	8·140406	8·141927	8·143443	12	1524
48	8·144953	8·146458	8·147959	8·149453	8·150943	8·152428	11	1493
49	8·153907	8·155382	8·156852	8·158316	8·159776	8·161231	10	1462
50	8·162681	8·164126	8·165566	8·167002	8·168433	8·169859	9	1432
51	8·171280	8·172697	8·174109	8·175517	8·176920	8·178319	8	1405
52	8·179713	8·181102	8·182488	8·183868	8·185245	8·186617	7	1379
53	8·187985	8·189348	8·190707	8·192062	8·193413	8·194760	6	1353
54	8·196102	8·197440	8·198774	8·200104	8·201430	8·202752	5	1328
55	8·204070	8·205384	8·206694	8·208000	8·209302	8·210601	4	1304
56	8·211895	8·213185	8·214472	8·215755	8·217034	8·218309	3	1281
57	8·219581	8·220849	8·222113	8·223374	8·224631	8·225884	2	1258
58	8·227133	8·228380	8·229622	8·230861	8·232096	8·233328	1	1237
59	8·234557	8·235782	8·237003	8·238221	8·239436	8·240647	0	1216
	60″	50″	40″	30″	20″	10″		

Co-sine 89 Degrees.

TABLE 5.

Logarithmic Tangents.

Tangent 0 Degree.

′	0″	10″	20″	30″	40″	50″		Diff.
0		5·685575	5·986605	6·162696	6·287635	6·384545	59	
1	6·463726	6·530673	6·588665	6·639817	6·685575	6·726968	58	
2	6·764756	6·799518	6·831703	6 861666	6·889695	6·916024	57	
3	6·940847	6·964329	6·986605	7·007794	7·027998	7·047303	56	
4	7·065786	7·083515	7·100548	7·116939	7·132733	7·147973	55	
5	7·162696	7·176937	7·190725	7·204089	7·217054	7·229643	54	
6	7·241878	7·253777	7·265359	7·276640	7·287635	7·298359	53	
7	7·308825	7·319044	7·329028	7·338788	7·348333	7·357673	52	
8	7·366817	7·375772	7·384546	7·393146	7·401579	7·409852	51	
9	7·417970	7·425939	7·433764	7·441451	7·449004	7·456428	50	
10	7·463727	7·470906	7·477968	7·484917	7·491756	7·498490	49	6894
11	7·505120	7·511651	7·518085	7·524426	7·530675	7·536835	48	6294
12	7·542909	7·548900	7·554808	7·560638	7·566390	7·572068	47	5791
13	7·577671	7·583204	7·588667	7·594062	7·599391	7·604655	46	5362
14	7·609857	7·514996	7·620076	7·625097	7·630060	7·634968	45	4992
15	7·639820	7·644619	7·649366	7·654061	7·658706	7·663301	44	4670
16	7·667849	7·672350	7·676804	7·681213	7·685578	7·689900	43	4387
17	7·694179	7·698416	7·702612	7·706768	7·710885	7·713962	42	4136
18	7·719003	7·723005	7·726972	7·730902	7·734797	7·738658	41	3913
19	7·742484	7·746277	7·750037	7·753765	7·757462	7·761127	40	3712
20	7·764761	7·768365	7·771940	7·775485	7·779002	7·782490	39	3531
21	7·785951	7·789384	7·792790	7·796170	7·799524	7·802852	38	3367
22	7·806155	7·809432	7·812686	7·815915	7·819120	7·822302	37	3217
23	7·825460	7·828596	7·831710	7·834801	7·837870	7·840918	36	3080
24	7·843944	7·846950	7·849935	7·852900	7·855844	7·858769	35	2954
25	7·861674	7·846560	7·867426	7·870174	7·873104	7·875915	34	2839
26	7·878708	7·881483	7·884240	7·886981	7·889704	7·892410	33	2732
27	7·895099	7·897771	7·900428	7·903068	7·905692	7·908301	32	2632
28	7·910894	7·913471	7·916034	7·918581	7·921113	7·923631	31	2540
29	7·926134	7·928623	7·931098	7·933559	7·936006	7·938439	30	2454
30	7·940858	7·943265	7·945657	7·948037	7·950404	7·952758	29	2373
31	7·955100	7·957428	7·959745	7·962049	7·964341	7·966621	28	2298
32	7·968889	7·971145	7·973389	7·975622	7·977844	7·980054	27	2227
33	7·982253	7·984441	7·986618	7·988785	7·990940	7·993085	26	2161
34	7·995219	7·997343	7·999456	8·001560	8·003653	8·005736	25	2098
35	8·007809	8·009872	8·011926	8·013970	8·016004	8·018029	24	2039
36	8·020044	8·022051	8·024047	8·026035	8.028014	8·029984	23	1983
37	8·031945	8·033897	8·035840	8·037775	8·039701	8·041618	22	1930
38	8·043527	8·045428	8·047321	8·049205	8·051081	8·052949	21	1880
39	8·054809	8·056661	8·058506	8·060342	8·062171	8·063992	20	1833
40	8.065806	8·067612	8·069410	8·071201	8·072985	8·074761	19	1787
41	8·076531	8·078293	8·080047	8·081795	8·083536	8·085270	18	1744
42	8·086997	8·088717	8·090430	8·092137	8·093837	8·095530	17	1703
43	8·097217	8·098897	8·100571	8·102239	8·103899	8·105554	16	1664
44	8·107202	8·108845	8·110481	8·112110	8·113734	8·115352	15	1627
45	8·116963	8·118569	8·120169	8·121763	8·123351	8·124933	14	1591
46	8·126510	8·128081	8·129646	8·131206	8·132760	8·134308	13	1557
47	8·135851	8·137389	8·138921	8·140447	8·141969	8·143485	12	1524
48	8·144996	8·146501	8·148001	8·149497	8·150987	8·152472	11	1493
49	8·153952	8·155426	8·156896	8·158361	8·159821	8·161276	10	1462
50	8·162727	8·164972	8·165613	8·167049	8·168480	8·169906	9	1424
51	8·171328	8·172745	8·174158	8·175566	8·176969	8·178368	8	1406
52	8·179763	8·181152	8·182538	8·183919	8·185296	8·186668	7	1379
53	8·188036	8·189400	8·190760	8·192115	8·193466	8·194813	6	1353
54	8·196156	8·197494	8·198829	8·200159	8·201485	8·202808	5	1328
55	8·204126	8·205440	8·206750	8·208057	8·209359	8·210658	4	1304
56	8·211953	8·213243	8·214530	8·215814	8·217093	8·218369	3	1284
57	8·219641	8·220909	8·222174	8·223434	8·224692	8·225945	2	1259
58	8·227195	8·228442	8·229685	8·230924	8·232160	8·233392	1	1238
59	8·234621	8·235846	8·237068	8·238286	8·239501	8·240713	0	1217
	60″	50″	40″	30″	20″	10″	′	

TABLE 4.

Logarithms of Numbers.

No. 6400——7000 Log. 806180——845098

No.	0	1	2	3	4	5.	6	7	8	9	Diff
640	806180	806248	806316	806384	806451	806519	806587	806655	806723	806790	68
641	806858	806926	806994	807061	807129	807197	807264	807332	807400	807467	68
642	807535	807603	807670	807738	807806	807873	807941	808008	808076	808143	68
643	808211	808279	808346	808414	808481	808549	808616	808684	808751	808818	68
644	808886	808953	809021	809088	809156	809223	809290	809358	809425	809492	67
645	809560	809627	809694	809762	809829	809896	809964	810031	810098	810165	67
646	810233	810300	810367	810434	810501	810569	810636	810703	810770	810837	67
647	810904	810971	811038	811106	811173	811240	811307	811374	811441	811508	67
648	811575	811642	811709	811776	811843	811910	811977	812044	812111	812178	67
649	812245	812312	812378	812445	812512	812579	812646	812713	812780	812847	67
650	812913	812980	813047	813114	813181	813247	813314	813381	813448	813514	67
651	813581	813648	813714	813781	813848	813914	813981	814048	814114	814181	67
652	814248	814314	814381	814447	814514	814581	814647	814714	814780	814847	67
653	814913	814980	815046	815113	815179	815246	815312	815378	815445	815511	66
654	815578	815644	815711	815777	815843	815910	815976	816042	816109	816175	66
655	816241	816308	816374	816440	816506	816573	816639	816705	816771	816838	66
656	816904	816970	817036	817102	817169	817235	817301	817367	817433	817499	66
657	817565	817631	817698	817764	817830	817896	817962	818028	818094	818160	66
658	818226	818292	818358	818424	818490	818556	818622	818688	818754	818819	66
659	818885	818951	819017	819083	819149	819215	819281	819346	819412	819478	66
660	819544	819610	819675	819741	819807	819873	819939	820004	820070	820136	66
661	820201	820267	820333	820399	820464	820530	820595	820661	820727	820792	66
662	820858	820924	820989	821055	821120	821186	821251	821317	821382	821448	66
663	821514	821579	821644	821710	821775	821841	821906	821972	822037	822103	65
664	822168	822233	822299	822364	822430	822495	822560	822626	822691	822756	65
665	822822	822887	822952	823018	823083	823148	823213	823279	823344	823409	65
666	823474	823539	823605	823670	823735	823800	823865	823930	823996	824061	65
667	824126	824191	824256	824321	824386	824451	824516	824581	824646	824711	65
668	824776	824841	824906	824971	825036	825101	825166	825231	825296	825361	65
669	825426	825491	825556	825621	825686	825751	825815	825880	825945	826010	65
670	826075	826140	826204	826269	826334	826399	826464	826528	826593	826658	65
671	826723	826787	826852	826917	826981	827046	827111	827175	827240	827305	65
672	827369	827434	827498	827563	827628	827692	827757	827821	827886	827951	65
673	828015	828080	828144	828209	828273	828338	828402	828467	828531	828595	64
674	828660	828724	828789	828853	828918	828982	829046	829111	829175	829239	64
675	829304	829368	829432	829497	829561	829625	829690	829754	829818	829882	64
676	829947	830011	830075	830139	830204	830268	830332	830396	830460	830525	64
677	830589	830653	830717	830781	830845	830909	830973	831037	831102	831166	64
678	831230	831194	831358	831422	831486	831550	831614	831678	831742	831806	64
679	831870	831934	831998	832062	832126	832189	832253	832317	832381	832445	64
680	832509	832573	832637	832700	832764	832828	832892	832956	833020	833083	64
681	833147	833211	833275	833338	833402	833466	833530	833593	833657	833721	64
682	833784	833848	833912	833975	834039	834103	834166	834230	834293	834357	64
683	834421	834484	834548	834611	834675	834739	834802	834866	834929	834993	64
684	835056	835120	835183	835247	835310	835373	835437	835500	835564	835627	63
685	835691	835254	835817	835881	835944	836007	836071	836134	836197	836261	63
686	836324	836387	836451	836514	836577	836641	836704	836767	836830	836894	63
687	836957	837020	837083	837146	837210	837273	837336	837399	837462	837525	63
688	837588	837652	837715	837778	837841	837904	837967	838030	838093	838156	63
689	838219	838282	838345	838408	838471	838534	838597	838660	838723	838786	63
690	838849	838912	838975	839038	839101	839164	839227	839289	839352	839415	63
691	839478	839541	839604	839667	839729	839792	839855	839918	839981	840043	63
692	840106	840169	840232	840294	840357	840420	840482	840545	840608	840671	63
693	840733	840796	840859	840921	840984	841046	841109	841172	841234	841297	63
694	841359	841422	841485	841547	841610	841672	841735	841797	841860	841922	63
695	841985	842047	842110	842172	842235	842297	842360	842422	842484	842547	62
696	842609	842672	842734	842796	842859	842921	842983	843046	843108	843170	62
697	843233	843295	843357	843420	843482	843544	843606	843669	843731	843793	62
698	843855	843918	843980	844042	844104	844166	844229	844291	844353	844415	62
699	844477	844539	844601	844664	844726	844788	844850	844912	844974	845036	62
	0	1	2	3	4	5	6	7	8	9	

Logarithmic Tangents.

Tangent 1 Degree.

′	0″	10″	20″	30″	40″	50″		Diff.
0	8·241921	8·243126	8·244328	8·245526	8·246721	8·247913	59	1197
1	8·249101	8·250287	8·251469	8·252648	8·253823	8·254996	58	1177
2	8·256165	8·257331	8·258494	8·259654	8·260811	8·261965	57	1158
3	8·263115	8·264263	8·265408	8·266549	8·267688	8·268824	56	1140
4	8·269956	8·271086	8·272213	8·273337	8·274458	8·275576	55	1122
5	8·276691	8·277804	8·278913	8·280020	8·281124	8·282225	54	1105
6	8·283323	8·284419	8·285512	8·286602	8·287689	8·288774	53	1089
7	8·289856	8·290935	8·292012	8·293086	8·294157	8·295226	52	1073
8	8·296292	8·297355	8·298416	8·299474	8·300530	8·301583	51	1057
9	8·302633	8·303682	8·304727	8·305770	8·306811	8·307849	50	1042
10	8.308884	8·309917	8·310948	8·311976	8·313002	8·314025	49	1027
11	8·315046	8·316065	8·317081	8·318095	8·319106	8·320115	48	1013
12	8·321122	8·322127	8·323129	8·324128	8·325126	8·326121	47	999
13	8·327114	8·328105	8·329093	8·330080	8·331064	8·332045	46	985
14	8·333025	8·334002	8·334977	8·335950	8·336921	8·337890	45	972
15	8·338856	8·339821	8·340783	8·341743	8·342701	8·343657	44	959
16	8·344610	8·345562	8·346512	8·347459	8·348405	8·349348	43	946
17	8·350289	8·351229	8·352166	8·353101	8·354035	8·354966	42	934
18	8·355895	8·356823	8·357748	8·358671	8·359593	8·360512	41	922
19	8·361430	8·362345	8·363259	8·364171	8·365080	8·365988	40	911
20	8·366894	8·367799	8·368701	8·369601	8·370500	8·371397	39	899
21	8·372291	8·373184	8·374076	8·374965	8·375853	8·376738	38	888
22	8·377622	8·378504	8·379385	8·380263	8·381140	8·382015	37	878
23	8·382889	8·383700	8·384630	8·385498	8·386364	8·387229	36	867
24	8·388092	8·388953	8·389812	8·390670	8·391526	8·392381	35	857
25	8·393234	8·394085	8·394934	8·395782	8·396628	8·397472	34	847
26	8·398315	8·399156	8·399996	8·400834	8·401670	8·402505	33	837
27	8·403338	8·404170	8·405000	8·405828	8·406655	8·407480	32	828
28	8·408304	8·409126	8·409946	8·410765	8·411583	8·412399	31	818
29	8·413213	8·414026	8·414837	8·415647	8·416456	8·417262	30	809
30	8·418068	8·418872	8·419674	8·420475	8·421274	8·422072	29	800
31	8·422869	8·423664	8·424458	8·425250	8·426040	8·426830	28	791
32	8·427618	8·428404	8·429189	8·429973	8.430755	8·431536	27	783
33	8·432315	8·433093	8·433870	8·434645	8·435419	8·436191	26	775
34	8·436962	8·437732	8·438500	8·439267	8·440033	8·440797	25	766
35	8·441560	8·442322	8·443082	8·443841	8·444599	8·445355	24	758
36	8·446110	8·446864	8·447616	8·448367	8·449117	8·449866	23	750
37	8·450613	8·451359	8·452104	8·452847	8·453589	8·454330	22	743
38	8·455070	8·455808	8·456545	8·457281	8·458016	8·458749	21	735
39	8·459481	8·460212	8·460942	8·461670	8·462398	8·463124	20	728
40	8·463849	8·464572	8·465295	8·466016	8·466736	8·467455	19	721
41	8·468172	8·468889	8·469604	8·470318	8·471031	8·471743	18	714
42	8·472454	8·473163	8·473871	8·474579	8·475285	8·475990	17	707
43	8·476693	8·477396	8·478597	8·478798	8·479497	8·480195	16	700
44	8·480892	8·481588	8·482283	8·482976	8·483669	8·484360	15	693
45	8·485050	8·485740	8·486428	8·487115	8·487801	8·488486	14	687
46	8·489170	8·489852	8·490534	8·491215	8·491894	8·492573	13	680
47	8·493250	8·493927	8·494602	8·495276	8·495949	8·496622	12	674
48	8·497293	8·497963	8·498632	8·499300	8·499967	8·500633	11	668
49	8·501298	8·501962	8·502625	8·503287	8·503948	8·504608	10	661
50	8·505267	8·505925	8·506582	8·507238	8·507893	8·508547	9	656
51	8·509200	8·509852	8·510503	8·511153	8·511802	8·512451	8	650
52	8·513098	8·513744	8·514389	8·515034	8·515677	8·516319	7	644
53	8·516961	8·517602	8·518241	8·518880	8·519517	8·520154	6	638
54	8·520790	8·521425	8·522059	8·522692	8·523324	8·523956	5	633
55	8·524586	8·525215	8·525844	8·526472	8·527098	8·527724	4	627
56	8·528349	8·528973	8·529596	8·530218	8·530840	8·531460	3	622
57	8·532080	8·532698	8·533316	8·533933	8·534549	8·535164	2	616
58	8·535779	8·536392	8·537005	8·537616	8·538227	8·538837	1	611
59	8·539447	8·540055	8 540662	8·541269	8·541875	8·542480	0	606
	60″	50″	40″	30″	20″	10″	′	

Co-tangent 88 Degrees.

TABLE 4.

Logarithms of Numbers.

No. 7600 —— 8200 Log. 880814 ——913814

No.	0	1	2	3	4	5	6	7	8	9	Diff
760	880814	880871	880928	880985	881042	881099	881156	881213	881270	881328	57
761	881385	881442	881499	881556	881613	881670	881727	881784	881841	881898	57
762	881955	882012	882069	882126	882183	882240	882297	882354	882411	882468	57
763	882524	882581	882638	882695	882752	882809	882866	882923	882980	883037	57
764	883093	883150	883207	883264	883321	883377	883434	883491	883548	883605	57
765	883661	883718	883775	883832	883888	883945	884002	884059	884115	884172	57
766	884229	884285	884342	884399	884455	884512	884569	884625	884682	884739	57
767	884795	884852	884909	884965	885022	885078	885135	885192	885248	885305	57
768	885361	885418	885474	885531	885587	885644	885700	885757	885813	885870	57
769	885926	885983	886039	886096	886152	886209	886265	886321	886378	886434	56
770	886491	886547	886604	886660	886716	886773	886829	886885	886942	886998	56
771	887054	887111	887167	887223	887280	887336	887392	887449	887505	887561	56
772	887617	887674	887730	887786	887842	887898	887955	888011	888067	888123	56
773	888179	888236	888292	888348	888404	888460	888516	888573	888629	888685	56
774	888741	888797	888853	888909	888965	889021	889077	889134	889190	889246	56
775	889302	889358	889414	889470	889526	889582	889638	889694	889750	889806	56
776	889862	889918	889974	890030	890086	890141	890197	890253	890309	890365	56
777	890421	890477	890533	890589	890644	890700	890756	890812	890868	890924	56
778	890980	891035	891091	891147	891203	891259	891314	891370	891426	891482	56
779	891537	891593	891649	891705	891760	891816	891872	891928	891983	892039	56
780	892095	892150	892206	892262	892317	892373	892429	892484	892540	892595	56
781	892651	892707	892762	892818	892873	892929	892985	893040	893096	893151	56
782	893207	893262	893318	893373	893429	893484	893540	893595	893651	893706	56
783	893762	893817	893873	893928	893984	894039	894094	894150	894205	894261	55
784	894316	894371	894427	894482	894538	894593	894648	894704	894759	894814	55
785	894870	894925	894980	895036	895091	895146	895201	895257	895312	895367	55
786	895423	895478	895533	895588	895643	895699	895754	895809	895864	895920	55
787	895975	896030	896085	896140	896195	896251	896306	896361	896416	896471	55
788	896526	896581	896636	896692	896747	896802	896857	896912	896967	897022	55
789	897077	897132	897187	897242	897297	897352	897407	897462	897517	897572	55
790	897627	897682	897737	897792	897847	897902	897957	898012	898067	898122	55
791	898176	898231	898286	898341	898396	898451	898506	898561	898615	898670	55
792	898725	898780	898835	898890	898944	898999	899054	899109	899164	899218	55
793	899273	899328	899383	899437	899492	899547	899602	899656	899711	899766	55
794	899820	899875	899930	899985	900039	900094	900149	900203	900258	900312	55
795	900367	900422	900476	900531	900586	900640	900695	900749	900804	900858	55
796	900913	900968	901022	901077	901131	901186	901240	901295	901349	901404	55
797	901458	901513	901567	901622	901676	901731	901785	901840	901894	901948	54
798	902003	902057	902112	902166	902221	902275	902329	902384	902438	902491	54
799	902547	902601	902655	902710	902764	902818	902873	902927	902981	903036	54
800	903090	903144	903198	903253	903307	903361	903416	903470	903524	903578	54
801	903632	903687	903741	903795	903849	903903	903958	904012	904066	904120	54
802	904174	904228	904283	904337	904391	904445	904499	904553	904607	904661	54
803	904715	904770	904824	904878	904932	904986	905040	905094	905148	905202	54
804	905256	905310	905364	905418	905472	905526	905580	905634	905688	905742	54
805	905796	905850	905904	905958	906012	906065	906119	906173	906227	906281	54
806	906335	906389	906443	906497	906550	906604	906658	906712	906766	906820	54
807	906873	906927	906981	907035	907089	907142	907196	907250	907304	907358	54
808	907411	907465	907519	907573	907626	907680	907734	907787	907841	907895	54
809	907948	908002	908056	908109	908163	908217	908270	908324	908378	908431	54
810	908485	908539	908592	908646	908699	908753	908807	908860	908914	908967	54
811	909021	909074	909128	909181	909235	909288	909342	909395	909449	909502	54
812	909556	909609	909663	909716	909770	909823	909877	909930	609984	910037	53
813	910090	910144	910197	910251	910304	910358	910411	910464	910518	610571	53
814	910624	910678	910731	910784	910838	910891	910944	910998	911051	911104	53
815	911158	911211	911264	911317	911371	911424	911477	911530	911584	911637	53
816	911690	911743	911797	911850	911903	911956	912009	912063	912116	912169	53
817	912222	912275	912328	912381	912435	912488	912541	912594	912647	912700	53
818	912753	912806	912859	912913	912966	913019	913072	913125	913178	913231	53
819	913284	913337	913390	913443	913496	913549	913602	913655	913708	913761	53
	0	1	2	3	4	5	6	7	8	9	

TABLE 5.

Logarithmic Sines, Tangents, and Secants.

0h. 4m. 1 Degree.

′	m s	Sine.	Diff.	Co-secant.	Tangent.	Diff.	Co-tang.	Secant.	D.	Co-sine.		′
0	0	8·241855	11963	11·758145	8·241921	11967	11·758079	10·000066	3	9·999934	56	60
1	4	8·249033	11768	11·750967	8·249102	11772	11·750898	10·000068	5	9·999932	56	59
2	8	8·256094	11580	11·743906	8·256165	11584	11·743835	10·000071	3	9·999929	52	58
3	12	8·263042	11397	11·736958	8·263115	11402	11·736885	10·000073	3	9·999927	48	57
4	16	8·269881	11221	11·730119	8·269956	11225	11·730044	10·000075	5	9·999925	44	56
5	20	8·276614	11050	11·723386	8·276691	11054	11·723309	10·000078	3	9·999922	40	55
6	24	8·283243	10883	11·716757	8·283323	10887	11·716677	10·000080	5	9·999920	36	54
7	28	8·289773	10722	11·710227	8·289856	10726	11·710144	10·000082	3	9·999918	32	53
8	32	8·296207	10565	11·703793	8·296292	10570	11·703708	10·000085	5	9·999915	28	52
9	36	8·302546	10413	11·697454	8·302634	10418	11·697366	10·000087	3	9·999913	24	51
10	40	8·308794	10266	11·691206	8·308884	10270	11·691116	10·000090	5	9·999910	20	50
11	44	8·314954	10122	11·685046	8·315046	10126	11·684954	10·000093	3	9·999907	16	49
12	48	8·321027	9982	11·678973	8·321122	9987	11·678878	10·000095	5	9·999905	12	48
13	52	8·327016	9847	11·672984	8·327114	9851	11·672886	10·000098	5	9·999902	8	47
14	56	8·332924	9714	11·667076	8·333025	9719	11·666975	10·000101	3	9·999899	4	46
15	5	8·338753	9586	11·661247	8·338856	9590	11·661144	10·000103	5	9·999897	55	45
16	4	8·344504	9460	11·655496	8·344610	9465	11·655390	10·000106	5	9·999894	56	44
17	8	8·350181	9338	11·649819	8·350289	9343	11·649711	10·000109	5	9·999891	52	43
18	12	8·355783	9219	11·644217	8·355895	9224	11·644105	10·000112	5	9·999888	48	42
19	16	8·361315	9103	11·638685	8·361430	9108	11·638570	10·000115	5	9·999885	44	41
20	20	8·366777	8990	11·633223	8·366895	8995	11·633105	10·000118	5	9·999882	40	40
21	24	8·372171	8880	11·627829	8·372292	8885	11·627708	10·000121	5	9·999879	36	39
22	28	8·377499	8772	11·622501	8·377622	8777	11·622378	10·000124	5	9·999876	32	38
23	32	8·382762	8667	11·617238	8·382889	8672	11·617111	10·000127	5	9·999873	28	37
24	36	8·387962	8564	11·612038	8·388092	8570	11·611908	10·000130	5	9·999870	24	36
25	40	8·393101	8464	11·606899	8·393234	8470	11·606766	10·000133	5	9·999867	20	35
26	44	8·398179	8366	11·601821	8·398315	8371	11·601685	10·000136	5	9·999864	16	34
27	48	8·403199	8271	11·596801	8·403338	8276	11·596662	10·000139	5	9·999861	12	33
28	52	8·408161	8177	11·591839	8·408304	8182	11·591696	10·000142	7	9·999858	8	32
29	56	8·413068	8086	11·586932	8·413213	8091	11·586787	10·000146	5	9·999854	4	31
30	6	8·417919	7996	11·582081	8·418068	8002	11·581932	10·000149	5	9·999851	54	30
31	4	8·422717	7909	11·577283	8·422869	7914	11·577131	10·000152	7	9·999848	56	29
32	8	8·427462	7823	11·572538	8·427618	7829	11·572382	10·000156	5	9·999844	52	28
33	12	8·432156	7740	11·567844	8·432315	7745	11·567685	10·000159	5	9·999841	48	27
34	16	8·436800	7657	11·563200	8·436962	7663	11·563038	10·000162	7	9·999838	44	26
35	20	8·441394	7577	11·558606	8·441560	7583	11·558440	10·000166	5	9·999834	40	25
36	24	8·445941	7499	11·554059	8·446110	7505	11·553890	10·000169	7	9·999831	36	24
37	28	8·454040	7422	11·549560	8·450613	7428	11·549387	10 000173	7	9·999827	32	23
38	32	8·454893	7346	11·545107	8·455070	7352	11·544930	10·000176	5	9·999824	28	22
39	36	8·459301	7273	11·540699	8·459481	7279	11·540519	10·000180	7	9·999820	24	21
40	40	8·463665	7200	11 536335	8·463849	7206	11·536151	10·000184	7	9·999816	20	20
41	44	8·467985	7129	11·532015	8·468172	7135	11·531828	10·000187	5	9·999813	16	19
42	48	8·472263	7060	11·527737	8·472454	7066	11·527546	10·000191	7	9·999809	12	18
43	52	8·476498	6991	11·523502	8·476693	6998	11·523307	10·000195	7	9·999805	8	17
44	56	8·480693	6924	11·519307	8·480892	6931	11·519108	10·000199	7	9·999801	4	16
45	7	8·484848	6859	11·515152	8·485050	6865	11·514950	10·000203	7	9·999797	53	15
46	4	8·488963	6794	11·511037	8·489170	6801	11·510830	10·000206	5	9·999794	56	14
47	8	8·493040	6731	11·506960	8·493250	6738	11·506750	10·000210	7	9·999790	52	13
48	12	8·497078	6669	11·502922	8·497293	6676	11·502707	10·000214	7	9·999786	48	12
49	16	8·501080	6608	11·498920	8·501298	6615	11·498702	10·000218	7	9·999782	44	11
50	20	8·505045	6548	11·494955	8·505267	6555	11·494733	10·000222	7	9·999778	40	10
51	24	8·508974	6489	11·491026	8·509200	6496	11·490800	10.000226	8	9·999774	36	9
52	28	8·512867	6432	11·487133	8·513098	6439	11·486902	10·000231	7	9·999769	32	8
53	32	8·516726	6375	11·483274	8·516961	6382	11·483039	10·000235	7	9·999765	28	7
54	36	8·520551	6319	11·479449	8·520790	6326	11·479210	10·000239	7	9·999761	24	6
55	40	8·524343	6264	11·475657	8·524586	6272	11·475414	10·000243	7	9·999757	20	5
56	44	8·528102	6211	11·471898	8·528349	6218	11·471651	10·000247	8	9·999753	16	4
57	48	8·531828	6158	11·468172	8·532080	6165	11·467920	10·000252	7	9·999748	12	3
58	52	8·535523	6106	11·464477	8·535779	6113	11·464221	10·000256	7	9·999744	8	2
59	56	8 539186	6055	11·460814	8·539147	6062	11·460553	10·000260	8	9·999740	4	1
60	8	8·542819		11·457181	8·543084		11·456916	10·000265		9·999735	0	0
′		Co-sine.		Secant.	Co.tang.		Tangent.	Co-secant.		Sine.	s m	′

88 Degrees. 5h. 52m.

TABLE 4.

Logarithms of Numbers.

No. 8800 ——9400 Log. 944483——973128

No.	0	1	2	3	4	5	6	7	8	9	Diff
880	944483	944532	944581	944631	944680	944729	944779	944828	944877	944927	49
881	944976	945025	945074	945124	945173	945222	945272	945321	945370	945419	49
882	945469	945518	945567	945616	945665	945715	945764	945813	945862	945911	49
883	945961	946010	946059	946108	946157	946207	946256	946305	946354	946403	49
884	946452	946501	946550	946600	946649	946698	946747	946796	946845	946894	49
885	946943	946992	947041	947090	947139	947189	947238	947287	947336	947385	49
886	947434	947483	947532	947581	947630	947679	947728	947777	947826	947875	49
887	947924	947973	948021	948070	948119	948168	948217	948266	948315	948364	49
888	948413	948462	948511	948560	948608	948657	948706	948755	948804	948853	49
889	948902	948951	948999	949048	949097	949146	949195	949244	949292	949341	49
890	949390	949439	949488	949536	949585	949634	949683	949731	949780	949829	49
891	949878	949926	949975	950024	950073	950121	950170	950219	950267	950316	49
892	950365	950413	950462	950511	950560	950608	950657	950705	950754	950803	49
893	950851	950900	950949	950997	951046	951095	951143	951192	951240	951289	49
894	951337	951386	951435	951483	951532	951580	951629	951677	951726	951774	49
895	951823	951872	951920	951969	952017	952066	952114	952163	952211	952259	48
896	952308	952356	952405	952453	952502	952550	952599	952647	952696	952744	48
897	952792	952841	952889	952938	952986	953034	953083	953131	953180	953228	48
898	953276	953325	953373	953421	953470	953518	953566	953615	953663	953711	48
899	953760	953808	953856	953905	953953	954001	954049	954098	954146	954194	48
900	954242	954291	954339	954387	954435	954484	954532	954580	954628	954677	48
901	954725	954773	954821	954869	954918	954966	955014	955062	955110	955158	48
902	955206	955255	955303	955351	955399	955447	955495	955543	955592	955640	48
903	955688	955736	855784	955832	955880	955928	955976	956024	956072	956120	48
904	956168	956216	956264	956312	956361	956409	956457	956505	956553	956601	48
905	956649	956697	956745	956792	956840	956888	956936	956984	957032	957080	48
906	957128	957176	957224	957272	957320	957368	957416	957464	957511	957559	48
907	957607	957655	957703	957751	957799	957847	957894	957942	957990	958038	48
908	958086	958134	958181	958229	958277	958325	958373	958420	958468	958516	48
909	958564	958612	958659	958707	958755	958803	958850	958898	958946	958994	48
910	959041	959089	959137	959184	959232	959280	959328	959375	959423	959471	48
911	959518	959566	959614	959661	959709	959757	959804	959852	959900	959947	48
912	959995	960042	960090	960138	960185	960233	960281	960328	960376	960423	48
913	960471	960518	960566	960613	960661	960709	960756	960804	960851	960899	48
914	960946	960994	961041	961089	961136	961184	961231	961279	961326	961374	48
915	961421	961469	961516	961563	961611	961658	961706	961753	961801	961848	47
916	961895	961943	961990	962038	962085	962132	962180	962227	962275	962322	47
917	962369	962417	962464	962511	962559	962606	962653	962701	962748	962795	47
918	962843	962890	962937	962985	963032	963079	963126	963174	963221	963268	47
919	963315	963363	963410	963457	963504	963552	963599	963646	963693	963741	47
920	963788	963835	963882	963929	963977	964024	964071	964118	964165	964212	47
921	964260	964307	964354	964401	964448	964495	964542	964590	964637	964684	47
922	964731	964778	964825	964872	964919	964966	965013	965060	965108	965155	47
923	965202	965249	965296	965343	965390	965437	965484	965531	965578	965625	47
924	965672	965719	965766	965813	965860	965907	965954	966001	966048	966095	47
925	966142	966189	966236	966283	966329	966376	966423	966470	966517	966564	47
926	966611	966658	966705	966752	966798	966845	966892	966939	966986	967033	47
927	967080	967127	967173	967220	967267	967314	967361	967408	967454	967501	47
928	967548	967595	967642	967688	967735	967782	967829	967875	967922	967969	47
929	968016	968062	968109	968156	968203	968249	968296	968343	968389	968436	47
930	968483	968530	968576	968623	968670	968716	968763	968810	968856	968903	47
931	968950	968996	969043	969090	969136	969183	969229	969276	969323	969369	47
932	969416	969462	969509	969556	969602	969649	969695	969742	969788	969835	47
933	969882	969928	969975	970021	970068	970114	970161	970207	970254	970300	47
934	970347	970393	970440	970486	970533	970579	970626	970672	970719	970765	47
935	970812	970858	970904	970951	970997	971044	971090	971137	971183	971229	46
936	971276	971322	971369	971415	971461	971508	971554	971600	971647	971693	46
937	971740	971786	971832	971879	971925	971971	972018	972064	972110	972156	46
938	972203	972249	972295	972342	972388	972434	972480	972527	972573	972619	46
939	972666	972712	972758	972804	972851	972897	972943	972989	973035	973082	46
	0	1	2	3	4	5	6	7	8	9	

TABLE 5.

Logarithmic Sines, Tangents, and Secants.

0h. 12m. 3 Degrees.

′	m s	Sine.	Diff.	Co-secant.	Tangent.	Diff.	Co-tang.	Secant.	D.	Co-sine.	s m	′
0	0	8.718800	4006	11·281200	8·719396	4017	11. 280604	10·000596	10	9·999404	48	60
1	4	8.721204	3984	11·278796	8·721806	3995	11·278194	10·000602	12	9·999398	56	59
2	8	8·723595	3962	11·276405	8·724204	3974	11·275796	10·000609	12	9·999391	52	58
3	12	8·725972	3941	11·274028	8·726588	3952	11·273412	10·000616	10	9·999384	48	57
4	16	8·728337	3919	11·271663	8·728959	3931	11·271041	10·000622	12	9·999378	44	56
5	20	8·730688	3808	11·269312	8·731317	3909	11·268683	10·000629	12	9·999371	40	55
6	24	8·733027	3877	11·266973	8·733663	3889	11·266337	10·000636	12	9·999364	36	54
7	28	8·735354	3857	11·264646	8·735996	3868	11·264004	10·000643	12	9·999357	32	53
8	32	8·737667	3836	11·262333	8·738317	3848	11·261683	10·000650	12	9·999350	28	52
9	36	8·739969	3816	11·260031	8·740626	3827	11·259374	10·000657	12	9·999343	24	51
10	40	8·742259	3796	11·257741	8·742922	3807	11·257078	10·000664	12	9·999336	20	50
11	44	8·744536	3776	11·255464	8·745207	3787	11·254793	10·000671	12	9·999329	16	49
12	48	8·746802	3756	11·253198	8·747479	3768	11·252521	10·000678	12	9·999322	12	48
13	52	8·749055	3737	11·250945	8·749740	3749	11·250260	10·000685	12	9·999315	8	47
14	56	8·751297	3717	11·248703	8·751989	3729	11·248011	10·000692	12	9·999308	4	46
15	13	8·753528	3698	11·246472	8·754227	3710	11·245773	10·000699	12	9·999301	47	45
16	4	8·755747	2679	11·244253	8·756453	3692	11·243547	10·000706	12	9·999294	56	44
17	8	8·757955	3661	11·242045	8·758668	3673	11·241332	10·000713	12	9·999287	52	43
18	12	8·760151	3642	11·239849	8·760872	3655	11·239128	10·000721	12	9·999279	48	42
19	16	8·762337	3624	11·237663	8·763065	3636	11·236935	10·000728	12	9·999272	44	41
20	20	8·764511	3606	11·235489	8·765246	3618	11·234754	10·000735	13	9·999265	40	40
21	24	8·766675	3588	11·233325	8·767417	3600	11·232583	10 000743	12	9·999257	36	39
22	28	8·768828	3570	11·231172	8·769578	3583	11·230422	10·000750	13	9·999250	32	38
23	32	8·770970	3553	11·229030	8·771727	3565	11·228273	10·000758	12	9·999242	28	37
24	36	8·773101	3535	11·226899	8·773866	3548	11·226134	10·000765	13	9·999235	24	36
25	40	8·775223	3518	11·224777	8·775995	3531	11·224005	10·000773	12	9·999227	20	35
26	44	8·777333	3501	11·222667	8·778114	3514	11·221886	10·000780	13	9·999220	16	34
27	48	8·779434	3484	11·220566	8·780222	3497	11·219778	10·000788	13	9·999212	12	33
28	52	8·781524	3467	11·218476	8·782320	3480	11·217680	10·000795	13	9·999205	8	32
29	56	8·783605	3451	11·216395	8·784408	3464	11·215592	10·000803	13	9·999197	4	31
30	14	8·785675	3434	11·214325	8·786486	3447	11·213514	10·000811	13	9·999189	46	30
31	4	8·787736	3418	11·212264	8·788554	3431	11·211446	10·000819	12	9·999181	56	29
32	8	8·789787	3402	11·210213	8·790613	3415	11·209387	10·000826	13	9·999174	52	28
33	12	8·791828	3386	11·208172	8·792662	3399	11·207338	10·000834	13	9·999166	48	27
34	16	8·793859	3370	11·206141	8·794701	3383	11·205299	10·000842	13	9·999158	44	26
35	20	8·795881	3354	11·204119	8·796731	3368	11·203269	10·000850	13	9·999150	40	25
36	24	8·797894	3339	11·202106	8·798752	3352	11·201248	10·000858	13	9·999142	36	24
37	28	8·799897	3323	11·200103	8·800763	3337	11·199237	10·000866	13	9·999134	32	23
38	32	8·801892	3308	11·198108	8·802765	3322	11·197235	10·000874	13	9·999126	28	22
39	36	8·803876	3293	11·196124	8·804758	3306	11·195242	10·000882	13	9·999118	24	21
40	40	8·805852	3278	11·194148	8·806742	3292	11·193258	10·000890	13	9·999110	20	20
41	44	8·807819	3263	11·192181	8·808717	3277	11·191283	10·000898	13	9·999102	16	19
42	48	8·809777	3249	11·190223	8·810683	3262	11·189317	10·000906	13	9·999094	12	18
43	52	8·811726	3234	11·188274	8·812641	3248	11·187359	10·000914	15	9·999086	8	17
44	56	8·813667	3219	11·186333	8·814589	3233	11·185411	10·000923	13	9·999077	4	16
45	15	8·815599	3205	11·184401	8·816529	3219	11·183471	10·000931	13	9·999069	45	15
46	4	8·817522	3191	11·182478	8·818461	3205	11·181539	10·000939	15	9·999061	56	14
47	8	8·819436	3177	11·180564	8·820384	3191	11·179616	10·000947	13	9·999053	52	13
48	12	8·821343	3163	11·178657	8·822298	3177	11·177702	10·000956	13	9·999044	48	12
49	16	8·823240	3149	11·176760	8·824205	3163	11·175795	10·000964	15	9·999036	44	11
50	20	8·825130	3135	11·174870	8·826103	3150	11·173897	10·000973	13	9·999027	40	10
51	24	8·827011	3122	11·172989	8·827992	3136	11·172008	10·000981	15	9·999019	36	9
52	28	8·828884	3108	11·171116	8·829874	3123	11·170126	10·000990	13	9·999010	32	8
53	32	8·830749	3095	11·169251	8·831748	3109	11·168252	10·000998	15	9·999002	28	7
54	36	8·832607	3082	11·167393	8·833613	3096	11·166387	10·001007	15	9·998993	24	6
55	40	8·834456	3069	11·165544	8·835471	3083	11·164529	10·001016	13	9·998984	20	5
56	44	8·836297	3056	11·163703	8·837321	3070	11·162679	10·001024	15	9·998976	16	4
57	48	8·838130	3043	11·161870	8·839163	3057	11·160837	10·001033	15	9·998967	12	3
58	52	8·839956	3030	11·160044	8·840998	3045	11·159002	10·001042	13	9·998958	8	2
59	56	8·841774	3017	11·158226	8·842825	3032	11·157175	10·001050	15	9·998950	4	1
60	16	8·843585		11·156415	8·844644		11·155356	10·001059		9·998941	0	0
′		Co-sine.		Secant.	Co-tang.		Tangent.	Co-secant.		Sine.	s m	′

86 Degrees. **5h. 44m.**

TABLE 5.

Logarithmic Sines, Tangents, and Secants.

0h. 16m. 4 Degrees.

′	m s	Sine.	Diff.	Co-secant.	Tangent.	Diff.	Co-tang.	Secant.	D.	Co-sine.		′
0	0	8·843585	3005	11·156415	8·844644	3019	11·155356	10·001059	15	9·998941	**44**	60
1	4	8·845387	2992	11·154613	8·846455	3007	11·153545	10·001068	15	9·998932	56	59
2	8	8·847133	2980	11·152817	8·848260	2995	11·151740	10·001077	15	9·998923	52	58
3	12	8·848971	2967	11·151029	8·850057	2982	11·149943	10·001086	15	9·998914	48	57
4	16	8·850751	2955	11·149249	8·851846	2970	11·148154	10·001095	15	9·998905	44	56
5	20	8·852525	2943	11·147475	8·853628	2958	11·146372	10·001104	15	9·998896	40	55
6	24	8·854291	2931	11·145709	8·855403	2946	11·144597	10·001113	15	9·998887	36	54
7	28	8·856049	2919	11·143951	8·857171	2935	11·142829	10·001122	15	9·998878	32	53
8	32	8·857801	2908	11·142199	8·858932	2923	11·141068	10·001131	15	9·998869	28	52
9	36	8·859546	2896	11·140454	8·860686	2911	11·139314	10·001140	15	9·998860	24	51
10	40	8·861283	2884	11·138717	8·862433	2900	11·137567	10·001149	17	9·998851	20	50
11	44	8·863014	2873	11·136986	8·864173	2888	11·135827	10·001159	15	9·998841	16	49
12	48	8·864738	2861	11·135262	8·865906	2877	11·134094	10·001168	15	9·998832	12	48
13	52	8·866455	2850	11·133545	8·867632	2866	11·132368	10·001177	17	9·998823	8	47
14	56	8·868165	2839	11·131835	8·869351	2854	11·130649	10·001187	15	9·998813	4	46
15	**17**	8·869868	2828	11·130132	8·871064	2843	11·128936	10·001196	15	9·998804	**43**	45
16	4	8·871565	2817	11·128435	8·872770	2832	11·127230	10·001205	17	9·998795	56	44
17	8	8·873255	2806	11·126745	8·874469	2821	11·125531	10·001215	15	9·998785	52	43
18	12	8·874938	2795	11·125062	8·876162	2811	11·123838	10·001224	17	9·998776	48	42
19	16	8·876615	2784	11·123385	8·877849	2800	11·122151	10·001234	15	9·998766	44	41
20	20	8·878285	2773	11·121715	8·879529	2789	11·120471	10·001243	17	9·998757	40	40
21	24	8·879949	2763	11·120051	8·881202	2779	11·118798	10·001253	17	9·998747	36	39
22	28	8·881607	2752	11·118393	8·882869	2768	11·117131	10·001262	15	9·998738	32	38
23	32	8·883258	2742	11·116742	8·884530	2758	11·115470	10·001272	17	9·998728	28	37
24	36	8·884903	2731	11·115097	8·886185	2747	11·113815	10·001282	17	9·998718	24	36
25	40	8·886542	2721	11·113458	8·887833	2737	11·112167	10·001292	15	9·998708	20	35
26	44	8·888174	2711	11·111826	8·889476	2727	11·110524	10·001301	17	9·998699	16	34
27	48	8·889801	2700	11·110199	8·891112	2717	11·108888	10·001311	17	9·998689	12	33
28	52	8·891421	2690	11·108579	8·892742	2707	11·107258	10·001321	17	9·998679	8	32
29	56	8·893035	2680	11·106965	8·894366	2697	11·105634	10·001331	17	9·998669	4	31
30	**18**	8·894643	2670	11·105357	8·895984	2687	11·104016	10·001341	17	9·998659	**42**	30
31	4	8·896246	2660	11·103754	8·897596	2677	11·102404	10·001351	17	9·998649	56	29
32	8	8·897842	2651	11·102158	8·899203	2667	11·100797	10·001361	17	9·998639	52	28
33	12	8·899432	2641	11·100568	8·900803	2658	11·099197	10·001371	17	9·998629	48	27
34	16	8·901017	2631	11·098983	8·902398	2648	11·097602	10·001381	17	9·998619	44	26
35	20	8·902596	2622	11·097404	8·903987	2638	11·096013	10·001391	17	9·998609	40	25
36	24	8·904169	2612	11·095831	8·905570	2629	11·094430	10·001401	17	9·998599	36	24
37	28	8·905736	2603	11·094264	8·907147	2620	11·092853	10·001411	18	9·998589	32	23
38	32	8·907297	2593	11·092703	8·908719	2610	11·091281	10·001422	17	9·998578	28	22
39	36	8·908853	2584	11·091147	8·910285	2601	11·089715	10·001432	17	9·998568	24	21
40	40	8·910404	2575	11·089596	8·911846	2592	11·088154	10·001442	17	9·998558	20	20
41	44	8·911949	2566	11·088051	8·913401	2583	11·086599	10·001452	18	9·998548	16	19
42	48	8·913488	2556	11·086512	8·914951	2574	11·085049	10·001463	17	9·998537	12	18
43	52	8·915022	2547	11·084978	8·916495	2565	11·083505	10·001473	18	9·998527	8	17
44	56	8·916550	2538	11·083450	8·918034	2556	11·081966	10·001484	17	9·998516	4	16
45	**19**	8·918073	2529	11·081927	8·919568	2547	11·080432	10·001494	18	9·998506	**41**	15
46	4	8·919591	2520	11·080409	8·921096	2538	11·078904	10·001505	17	9·998495	56	14
47	8	8·921103	2512	11·078897	8·922619	2530	11·077381	10·001515	18	9·998485	52	13
48	12	8·922610	2503	11·077390	8·924136	2521	11·075864	10·001526	17	9·998474	48	12
49	16	8·924112	2494	11·075888	8·925649	2512	11·074351	10·001536	18	9·998464	44	11
50	20	8·925609	2486	11·074391	8·927156	2503	11·072844	10·001547	18	9·998453	40	10
51	24	8·927100	2477	11·072900	8·928658	2495	11·071342	10·001558	18	9·998442	36	9
52	28	8·928587	2469	11·071413	8·930155	2486	11·069845	10·001569	17	9·998431	32	8
53	32	8·930068	2460	11·069932	8·931647	2478	11·068353	10·001579	18	9·998421	28	7
54	36	8·931544	2452	11·068456	8·933134	2470	11·066866	10·001590	18	9·998410	24	6
55	40	8·933015	2443	11·066985	8·934616	2461	11·065384	10·001601	18	9·998399	20	5
56	44	8·934481	2435	11·065519	8·936093	2453	11·063907	10·001612	18	9·998388	16	4
57	48	8·935842	2427	11·064058	8·937565	2445	11·062435	10·001623	18	9·998377	12	3
58	52	8·937398	2419	11·062602	8·939032	2437	11·060968	10·001634	18	9·998366	8	2
59	56	8·938850	2411	11·061150	8·940494	2429	11·059506	10·001645	18	9·998355	4	1
60	**20**	8·940296		11·059704	8·941952		11·058048	10·001656		9·998344	0	0
′		Co-sine.		Secant.	Co-tang.		Tangent.	Co-secant.		Sine.	s m	′

85 Degrees. 5h. 40m.

TABLE 5.

Logarithmic Sines, Tangents, and Secants.

0h. 20m. 5 Degrees.

′	m s	Sine.	Diff.	Co-secant.	Tangent.	Diff.	Co-tang.	Secant.	D.	Co-sine.		′
0	0	8·940296	2403	11·059704	8·941952	2421	11·058048	10·001656	18	9·998344	**40**	60
1	4	8·941738	2394	11·058262	8·943404	2413	11·056596	10·001667	18	9·998333	56	59
2	8	8·943174	2387	11·056826	8·944852	2405	11·055148	10·001678	18	9·998322	52	58
3	12	8·944606	2379	11·055394	8·946293	2397	11·053705	10·001689	18	9·998311	48	57
4	16	8·946034	2371	11·053966	8·947734	2390	11·052266	10·001700	18	9·998300	44	56
5	20	8·947456	2363	11·052544	8·949168	2382	11·050832	10·001711	20	9·998389	40	55
6	24	8·948874	2355	11·051126	8·950597	2374	11·049403	10·001723	18	9·998277	36	54
7	28	8·950287	2348	11·049713	8·952021	2366	11·047979	10·001734	18	9·998266	32	53
8	32	8·951696	2340	11·048304	8·953441	2359	11·046559	10·001745	20	9·998255	28	52
9	36	8·953100	2332	11·046900	8·954856	2351	11·045144	10·001757	18	9·998243	24	51
10	40	8·954499	2325	11·045501	8·956267	2344	11·043733	10·001768	20	9·998232	20	50
11	44	8·955894	2317	11·044106	8·957674	2336	11·042326	10·001780	18	9·998220	16	49
12	48	8·957284	2310	11·042716	8·959075	2329	11·040925	10·001791	20	9·998209	12	48
13	52	8·958670	2302	11·041330	8·960473	2322	11·039527	10·001803	18	9·998197	8	47
14	56	8·960052	2295	11·039948	8·961866	2314	11·038134	10·001814	20	9·998186	4	46
15	**21**	8·961429	2288	11·038571	8·963255	2307	11·036745	10·001826	18	9·998174	**39**	45
16	4	8·962801	2280	11·037199	8·964639	2300	11·035361	10·001837	20	9·998163	56	44
17	8	8·964170	2273	11·035830	8·966019	2293	11·033981	10·001849	20	9·998151	52	43
18	12	8·965534	2266	11·034466	8·967394	2286	11·032606	10·001861	18	9·998139	48	42
19	16	8·966893	2259	11·033107	8·968766	2279	11·031234	10·001872	20	9·998128	44	41
20	20	8·968249	2252	11·031751	8·970133	2271	11·029867	10·001884	20	9·998116	40	40
21	24	8·969600	2245	11·030400	8·971496	2265	11·028504	10·001896	20	9·998104	36	39
22	28	8·970947	2238	11·029053	8·972855	2257	11·027145	10·001908	20	9·998092	32	38
23	32	8·972289	2231	11·027711	8·974209	2251	11·025791	10·001920	20	9·998080	28	37
24	36	8·973628	2224	11·026372	8·975560	2244	11·024440	10·001932	20	9·998068	24	36
25	40	8·974962	2217	11·025038	8·976906	2237	11·023094	10·001944	20	9·998056	20	35
26	44	8·976293	2210	11·023707	8·978248	2230	11·021752	10·001956	20	9.998044	16	34
27	48	8·977619	2203	11·022381	8·979586	2223	11·020414	10·001968	20	9.998032	12	33
28	52	8·978941	2197	11·021059	8·980921	2217	11·019079	10·001980	20	9.998020	8	32
29	56	8·980259	2190	11·019741	8·982251	2210	11·017749	10·001992	20	9.998008	4	31
30	**22**	8·981573	2183	11·018427	8·983577	2204	11·016423	10·002004	20	9.997996	**38**	30
31	4	8·982883	2177	11·017117	8·984899	2197	11·015101	10·002016	20	9·997984	56	29
32	8	8·984189	2170	11·015811	8·986217	2191	11·013783	10·002028	22	9·997972	52	28
33	12	8·985491	2163	11·014509	8·987532	2184	11·012468	10·002041	20	9·997959	48	27
34	16	8·986789	2157	11·013211	8·988842	2178	11·011158	10·002053	20	9·997947	44	26
35	20	8·988083	2150	11·011917	8·990149	2171	11·009851	10·002065	22	9·997935	40	25
36	24	8·989374	2144	11·010626	8·991451	2165	11·008549	10·002078	20	9·997922	36	24
37	28	8·990660	2138	11·009340	8·992750	2158	11 007250	10·002090	22	9·997910	32	23
38	32	8·991943	2131	11·008057	8·994045	2152	11·005955	10·002103	20	9·997897	28	22
39	36	8·993222	2125	11·006778	8·995337	2146	11·004663	10·002115	22	9·997885	24	21
40	40	8·994497	2119	11·005503	8·996624	2140	11·003376	10·002128	20	9·997872	20	20
41	44	8·995768	2112	11·004232	8·997908	2134	11·002092	10·002140	22	9·997860	16	19
42	48	8·997036	2106	11·002964	8·999188	2127	11·000812	10·002153	20	9·997847	12	18
43	52	8·998299	2100	11·001701	9·000465	2121	10·999535	10·002165	22	9·997835	8	17
44	56	8·999560	2094	11·000440	9·001738	2115	10·998262	10·002178	22	9·097822	4	16
45	**23**	9·000816	2088	10·999184	9·003007	2109	10·996993	10·002191	20	9·997809	**37**	15
46	4	9·002069	2082	10·997931	9·004272	2103	10·995728	10·002203	22	9·997797	56	14
47	8	9·003318	2076	10·996682	9·005534	2097	10·994466	10·002216	22	9·997784	52	13
48	12	9·004563	2070	10·995437	9·006792	2091	10·993208	10·002229	22	9·997771	48	12
49	16	9.005805	2064	10·994195	9·008047	2085	10.991953	10·002242	22	9·997758	44	11
50	20	9·007044	2058	10·992956	9·009298	2079	10·990702	10·002255	22	9·997745	40	10
51	24	9·008278	2052	10·991722	9·010546	2074	10·989454	10·002268	22	9·997732	36	9
52	28	9·009510	2046	10·990490	9·011790	2068	10·988210	10·002281	22	9·997719	32	8
53	32	9·010737	2040	10·989263	9·013031	2062	10·986969	10·002294	22	9·997706	28	7
54	36	9·011962	2034	10·988038	9·014268	2056	10·985732	10·002307	22	9·997693	24	6
55	40	9·013182	2029	10·986818	9·015502	2051	10·984498	10·002320	22	9·997680	20	5
56	44	9·014400	2023	10·985600	9·016732	2045	10·983268	10·002333	22	9·997667	16	4
57	48	9·015613	2017	10·984387	9·017959	2039	10·982041	10·002346	22	9·997654	12	3
58	52	9·016824	2012	10·983176	9·019183	2034	10·980817	10·002359	22	9·997641	8	2
59	56	9·018031	2006	10·981969	9·020403	2028	10·979597	10·002372	23	9·997628	4	1
60	**24**	9·019235		10·980765	9·021620		10·978380	10·002386		9·997614	0	0
′		Co-sine.		Secant.	Co-tang.		Tangent.	Co-secant.		Sine.	s m	′

84 Degrees. 5h. 36m.

TABLE 5.

Logarithmic Sines, Tangents, and Secants.

0h. 24m. 6 Degrees.

′	m s	Sine.	Diff.	Co-secant.	Tangent.	Diff.	Co-tang.	Secant.	D.	Co-sine.		′
0	0	9·019235	2000	10·980765	9·021620	2023	10·978380	10·002386	22	9·997614	**36**	60
1	4	9·020435	1995	10·979565	9·022834	2017	10·977166	10·002399	22	9·997601	56	59
2	8	9·021632	1989	10·978368	9·024044	2011	10·975956	10·002412	23	9·997588	52	58
3	12	9·022825	1984	10·977175	9·025251	2006	10·974749	10·002426	22	9·997574	48	57
4	16	9·024016	1978	10·975984	9·026455	2001	10·973545	10·002439	23	9·997561	44	56
5	20	9·025203	1973	10·974797	9·027655	1995	10·972345	10·002453	22	9·997547	40	55
6	24	9·026386	1967	10·973614	9·028852	1990	10·971148	10·002466	23	9·997534	36	54
7	28	9·027567	1962	10·972433	9·030046	1985	10·969954	10·002480	22	9·997520	32	53
8	32	9·028744	1957	10·971256	9·031237	1979	10·968763	10·002493	23	9·997507	28	52
9	36	9·029918	1951	10·970082	9·032425	1974	10·967575	10·002507	22	9·997493	24	51
10	40	9·031089	1946	10·968911	9·033609	1969	10·966391	10·002520	23	9·997480	20	50
11	44	9·032257	1941	10·967743	9·034791	1964	10·965209	10·002534	23	9·997466	16	49
12	48	9·033421	1936	10·966579	9·035969	1958	10·964031	10·002548	22	9·997452	12	48
13	52	9·034582	1930	10·965418	9·037144	1953	10·962856	10·002561	23	9·997439	8	47
14	56	9·035741	1925	10·964259	9·038316	1948	10 961684	10·002575	23	9·997425	4	46
15	**25**	9·036896	1920	10·963104	9·039485	1943	10·960515	10·002589	23	9·997411	**35**	45
16	4	9·038048	1915	10·961952	9·040651	1938	10·959349	10·002603	23	9·997397	56	44
17	8	9·039197	1910	10·960803	9·041813	1933	10·958187	10·002617	23	9·997383	52	43
18	12	9·040342	1905	10·959658	9·042973	1928	10·957027	10·002631	23	9·997369	48	42
19	16	9·041485	1899	10·958515	9·044130	1923	10·955870	10·002645	23	9·997355	44	41
20	20	9·042625	1895	10·957375	9·045284	1918	10·954716	10·002659	23	9·997341	40	40
21	24	9·043762	1889	10·956238	9·046434	1913	10·953566	10·002673	23	9·997327	36	39
22	28	9·044895	1884	10·955105	9·047582	1908	10·952418	10·002687	23	9·997313	32	38
23	32	9·046026	1879	10·953974	9·048727	1903	10·951273	10·002701	23	9·997299	28	37
24	36	9 047154	1875	10·952846	9·049869	1898	10·950131	10·002715	23	9·997285	24	36
25	40	9·048279	1870	10·951721	9·051008	1893	10·948992	10·002729	23	9·997271	20	35
26	44	9·049400	1865	10·950600	9·052144	1889	10·947856	10·002743	25	9·997257	16	34
27	48	9·050519	1860	10·949481	9·053277	1884	10·946723	10·002758	23	9·997242	12	33
28	52	9·051635	1855	10·948365	9·054407	1879	10·945593	10·002772	23	9·997228	8	32
29	56	9·052749	1850	10·947251	9·055535	1874	10·944465	10·002786	25	9·997214	4	31
30	**26**	9·053859	1845	10·946141	9·056659	1870	10·943341	10·002801	23	9·997199	**34**	30
31	4	9·054966	1841	10·945034	9·057781	1865	10·942219	10·002815	25	9·997185	56	29
32	8	9·056071	1836	10·943929	9·058900	1860	10·941100	10·002830	23	9·997170	52	28
33	12	9·057172	1831	10·942828	9·060016	1855	10·939984	10·002844	25	9·997156	48	27
34	16	9·058271	1827	10·941729	9·061130	1851	10·938870	10·002859	23	9·997141	44	26
35	20	9 059367	1822	10·940633	9·062240	1846	10·937760	10·002873	25	9·997127	40	25
36	24	9·060460	1817	10·939540	9·063348	1842	10·936652	10·002888	23	9·997112	36	24
37	28	9·061551	1813	10·938449	9·064453	1837	10·935547	10·002902	25	9·997098	32	23
38	32	9·062639	1808	10·937361	9·065556	1833	10·934444	10·002917	25	9·997083	28	22
39	36	9·063724	1804	10·936276	9·066655	1828	10·933345	10·002932	25	9·997068	24	21
40	40	9·064806	1799	10·935194	9·067752	1824	10·932248	10·002947	23	9·997053	20	20
41	44	9·065885	1794	10·934115	9·068846	1819	10·931154	10·002961	25	9·997039	16	19
42	48	9·066962	1790	10·933038	9·069938	1815	10·930062	10·002976	25	9·997024	12	18
43	52	9·068036	1786	10·931964	9·071027	1810	10·928973	10·002991	25	9·997009	8	17
44	56	9·069107	1781	10·930893	9·072113	1806	10·927887	10·003006	25	9·996994	4	16
45	**27**	9·070176	1777	10·929824	9·073197	1802	10·926803	10·003021	25	9·996979	**33**	15
46	4	9·071242	1772	10·928758	9·074278	1797	10·925722	10·003036	25	9·996964	56	14
47	8	9·072306	1768	10·927694	9·075356	1793	10·924644	10·003051	25	9·996949	52	13
48	12	9·073366	1763	10·926634	9·076432	1789	10·923568	10·003066	25	9·996934	48	12
49	16	9·074424	1759	10·925576	9 077505	1784	10·922495	10·003081	25	9·996919	44	11
50	20	9·075480	1755	10·924520	9·078576	1780	10·921424	10·003096	25	9·996904	40	10
51	24	9·076533	1750	10·923467	9·079644	1776	10·920356	10·003111	25	9·996889	36	9
52	28	9·077583	1746	10·922417	9·080710	1772	10·919290	10·003126	27	9·996874	32	8
53	32	9·078631	1742	10·921369	9·081773	1767	10·918227	10·003142	25	9·996858	28	7
54	36	9·079676	1738	10·920324	9·082833	1763	10·917167	10·003157	25	9·996843	24	6
55	40	9·080719	1733	10·919281	9·083891	1759	10·916109	10·003172	27	9·996828	20	5
56	44	9·081759	1729	10·918241	9·084947	1755	10·915053	10·003188	25	9·996812	16	4
57	48	9·082797	1725	10·917203	9·086000	1751	10·914000	10·003203	25	9·996797	12	3
58	52	9·083832	1721	10·916168	9·087050	1747	10·912950	10·003218	27	9·996782	8	2
59	56	9·084864	1717	10·915136	9·088098	1743	10·911902	10·003234	25	9·996766	4	1
60	**28**	9·085894		10·914106	9·089144		10·910856	10·003249		9·996751	0	0
′		Co-sine.		Secant.	Co-tang.		Tangent.	Co-secant.		Sine.	s m	′

83 Degrees. 5h. 32m.

TABLE 5.

Logarithmic Sines, Tangents, and Secants.

0h. 28m. 7 Degrees.

′	m s	Sine.	Diff.	Co-secant.	Tangent.	Diff.	Co-tang.	Secant.	D.	Co-sine.		′
0	0	9·085894	1713	10·914106	9·089144	1738	10·910856	10·003249	27	9·996751	32	60
1	4	9·086922	1709	10·913078	9·090187	1735	10·909813	10·003265	25	9·996735	56	59
2	8	9·087947	1704	10·912053	9·091228	1731	10·908772	10·003280	27	9·996720	52	58
3	12	9·088970	1700	10·911030	9·092266	1727	10·907734	10·003296	27	9·996704	48	57
4	16	9·089990	1696	10·910010	9·093302	1722	10·906698	10·003312	25	9·996688	44	56
5	20	9·091008	1692	10·908992	9·094336	1719	10·905664	10·003327	27	9·996673	40	55
6	24	9·092024	1688	10·907976	9·095367	1715	10·904633	10·003343	27	9·996657	36	54
7	28	9·093037	1684	10·906963	9·096395	1711	10·903605	10·003359	27	9·996641	32	53
8	32	9·094047	1680	10·905953	9·097422	1707	10·902578	10·003375	25	9·996625	28	52
9	36	9·095056	1676	10·904944	9·098446	1703	10·901554	10·003390	27	9·996610	24	51
10	40	9·096062	1673	10·903938	9·099468	1699	10·900532	10·003406	27	9·996594	20	50
11	44	9·097065	1668	10·902935	9·100487	1695	10·899513	10·003422	27	9.996578	16	49
12	48	9·098066	1665	10·901934	9·101504	1691	10·898496	10·003438	27	9·996562	12	48
13	52	9·099065	1661	10·900935	9·102519	1687	10·897481	10·003454	27	9·996546	8	47
14	56	9·100062	1657	10·899938	9·103532	1684	10·896468	10·003470	27	9·996530	4	46
15	29	9·101056	1653	10·898944	9·104542	1680	10·895458	10·003486	27	9·996514	31	45
16	4	9·102048	1649	10·897952	9·105550	1676	10·894450	10·003502	27	9·996498	56	44
17	8	9·103037	1645	10·896963	9·106556	1672	10·893444	10·003518	28	9·996482	52	43
18	12	9·104025	1642	10·895975	9·107559	1669	10·892441	10·003535	27	9·996465	48	42
19	16	9·105010	1638	10·894990	9·108560	1665	10·891440	10·003551	27	9·996449	44	41
20	20	9·105992	1634	10·894008	9·109559	1661	10·890441	10·003567	27	9·996433	40	40
21	24	9·106973	1630	10·893027	9·110556	1658	10·889444	10·003583	28	9·996417	36	39
22	28	9·107951	1627	10·892049	9·111551	1654	10·888449	10·003600	27	9·996400	32	38
23	32	9·108927	1623	10·891073	9·112543	1650	10·887457	10·003616	27	9·996384	28	37
24	36	9·109901	1619	10·890099	9·113533	1647	10·886467	10·003632	28	9·996368	24	36
25	40	9·110873	1616	10·889127	9·114521	1643	10·885479	10·003649	27	9·996351	20	35
26	44	9·111842	1612	10·888158	9·115507	1639	10·884493	10·003665	28	9·996335	16	34
27	48	9·112809	1608	10·887191	9·116491	1636	10·883509	10·003682	27	9·996318	12	33
28	52	9·113774	1605	10·886226	9·117472	1632	10·882528	10·003698	28	9·996302	8	32
29	56	9·114737	1601	10·885263	9·118452	1629	10·881548	10·003715	27	9·996285	4	31
30	30	9·115698	1597	10·884302	9·119429	1625	10·880571	10·003731	28	9·996269	30	30
31	4	9·116656	1594	10·883344	9·120404	1622	10·879596	10·003748	28	9·996252	56	29
32	8	9·117613	1590	10·882387	9·121377	1618	10·878623	10·003765	27	9·996235	52	28
33	12	9·118567	1587	10·881433	9·122348	1615	10·877652	10·003781	28	9·996219	48	27
34	16	9·119519	1583	10·880481	9·123317	1611	10·876683	10·003798	28	9·996202	44	26
35	20	9·120469	1580	10·879531	9·124284	1608	10·875716	10·003815	28	9·996185	40	25
36	24	9·121417	1576	10·878583	9·125249	1604	10·874751	10·003832	28	9·996168	36	24
37	28	9·122362	1573	10·877638	9·126211	1601	10·873789	10·003849	28	9·996151	32	23
38	32	9·123306	1569	10·876694	9·127172	1597	10·872828	10·003866	28	9·996134	28	22
39	36	9·124248	1566	10·875752	9·128130	1594	10·871870	10·003883	28	9 996117	24	21
40	40	9·125187	1562	10·874813	9·129087	1591	10·870913	10·003900	28	9·996100	20	20
41	44	9·126125	1559	10·873875	9·130041	1587	10·869959	10·003917	28	9·996083	16	19
42	48	9·127060	1556	10·872940	9·130994	1584	10·869006	10·003934	28	9·996066	12	18
43	52	9·127993	1552	10·872007	9·131944	1581	10·868056	10·003951	28	9·996049	8	17
44	56	9·128925	1549	10·871075	9·132893	1577	10·867107	10·003968	28	9·996032	4	16
45	31	9·129854	1545	10·870146	9·133839	1574	10·866161	10·003985	28	9·996015	29	15
46	4	9·130781	1542	10·869219	9·134784	1571	10·865216	10·004002	30	9·995998	56	14
47	8	9·131706	1539	10·868294	9·135726	1567	10·864274	10·004020	28	9·995980	52	13
48	12	9·132630	1535	10·867370	9·136667	1564	10·863333	10·004037	28	9·995963	48	12
49	16	9·133551	1532	10·866449	9·137605	1561	10·862395	10·004054	30	9·995946	44	11
50	20	9·134470	1529	10·865530	9·138542	1558	10·861458	10·004072	28	9·995928	40	10
51	24	9·135387	1525	10·864613	9·139476	1555	10·860524	10·004089	28	9·995911	36	9
52	28	9·136303	1522	10·863697	9·140409	1551	10·859591	10·004106	30	9·995894	32	8
53	32	9·137216	1519	10·862784	9·141340	1548	10·858660	10·004124	28	9·995876	28	7
54	36	9·138128	1516	10·861872	9·142269	1545	10·857731	10·004141	30	9·995859	24	6
55	40	9·139037	1512	10·860963	9·143196	1542	10·856804	10·004159	30	9·995841	20	5
56	44	9·139944	1509	10·860056	9·144121	1539	10·855879	10·004177	28	9·995823	16	4
57	48	9·140850	1506	10·859150	9·145044	1535	10·854956	10·004194	30	9·995806	12	3
58	52	9·141754	1503	10·858246	9·145966	1532	10·854034	10·004212	28	9·995788	8	2
59	56	9·142655	1500	10·857345	9·146885	1529	10·853115	10·004229	30	9·995771	4	1
60	32	9·143555		10·856445	9·147803		10·852197	10·004247		9·995753	0	0
′		Co-sine.		Secant.	Co-tang.		Tangent.	Co-secant.		Sine.	s m	′

82 Degrees. N 5h. 28m.

TABLE 5.

Logarithmic Sines, Tangents, and Secants.

0h. 0m. 0 Degree.

′	m s	Sine.	Diff.	Co-secant.	Tangent.	Diff.	Co.tang.	Secant.	D	Co-sine.		′
0	0	0·000000		Infinite.	0·000000		Infinite.	10·000000	0	10·000000	60	60
1	4	6·463726	501717	13·536274	6·463726	501717	13·536274	10·000000	0	10·000000	56	59
2	8	6·764756	293485	13·235244	6·764756	293485	13·235244	10·000000	0	10·000000	52	58
3	12	6·940847	208231	13·059153	6·940847	208231	13·059153	10·000000	0	10·000000	48	57
4	16	7·065786	161517	12·934214	7·065786	161517	12·934214	10·000000	0	10·000000	44	56
5	20	7·162696	131968	12·837304	7·162696	131969	12·837304	10·000000	0	10·000000	40	55
6	24	7·241877	111578	12·758123	7·241878	111578	12·758122	10·000001	0	9·999999	36	54
7	28	7·308824	96653	12·691176	7·308825	96653	12·691175	10·000001	0	9·999999	32	53
8	32	7·366816	85254	12·633184	7·366817	85254	12·633183	10·000001	0	9·999999	28	52
9	36	7·417968	76262	12·582032	7·417970	76263	12·582030	10·000001	1	9·999999	24	51
10	40	7·463726	68988	12·536274	7·463727	68988	12·536273	10·000002	0	9·999998	20	50
11	44	7·505118	62981	12·494882	7·505120	62981	12·494880	10·000002	1	9·999998	16	49
12	48	7·542906	57936	12·457094	7·542909	57937	12·457091	10·000003	0	9·999997	12	48
13	52	7·577668	53641	12·422332	7·577672	53642	12·422328	10·000003	1	9·999997	8	47
14	56	7·609853	49938	12·390147	7·609857	49939	12·390143	10·000004	0	9·999996	4	46
15	1	7·639816	46714	12·360184	7·639820	46715	12·360180	10·000004	1	9·999996	59	45
16	4	7·667845	43881	12·332155	7·667849	43882	12·332151	10·000005	0	9·999995	56	44
17	8	7·694173	41372	12·305827	7·694179	41373	12·305821	10·000005	1	9·999995	52	43
18	12	7·718997	39135	12·281003	7·719003	39136	12 280997	10·000006	1	9·999994	48	42
19	16	7·742478	37127	12·257522	7·742484	37128	12·257516	10·000007	0	9·999993	44	41
20	20	7·764754	35315	12·235246	7·764761	35315	12·235239	10·000007	1	9·999993	40	40
21	24	7·785943	33672	12·214057	7·785951	33673	12·214049	10·000008	1	9·999992	36	39
22	28	7·806146	32175	12·193854	7·806155	32176	12·193845	10·000009	1	9·999991	32	38
23	32	7·825451	30805	12·174549	7·825460	30807	12·174540	10·000010	1	9·999990	28	37
24	36	7·843934	29547	12·156066	7·843944	29549	12·156056	10·000011	1	9·999989	24	36
25	40	7·861662	28388	12·138338	7·861674	28390	12·138326	10·000011	0	9·999989	20	35
26	44	7·878695	27317	12·121305	7·878708	27318	12·121292	10·000012	1	9·999988	16	34
27	48	7·895085	26323	12·104915	7·895099	26325	12·104901	10·000013	1	9·999987	12	33
28	52	7·910879	25399	12·089121	7·910894	25401	12·089106	10·000014	1	9·999986	8	32
29	56	7·926119	24538	12·073881	7·926134	24540	12·073866	10·000015	1	9·999985	4	31
30	2	7·940842	23733	12·059158	7·940858	23735	12·059142	10·000017	3	9·999983	58	30
31	4	7·955082	22980	12·044918	7·955100	22982	12·044900	10·000018	1	9·999982	56	29
32	8	7·968870	22273	12·031130	7·968889	22275	12·031111	10·000019	1	9·999981	52	28
33	12	7·982233	21608	12·017767	7·982253	21610	12·017747	10·000020	1	9·999980	48	27
34	16	7·995198	20981	12·004802	7·995219	20983	12·004781	10·000021	3	9·999979	44	26
35	20	8·007787	20390	11·992213	8 007809	20392	11·992191	10·000023	1	9·999977	40	25
36	24	8·020021	19831	11·979979	8·020045	19833	11·975955	10·000024	1	9·999976	36	24
37	28	8·031919	19302	11·968081	8·031945	19305	11·968055	10·000025	1	9·999975	32	23
38	32	8·043501	18801	11·956499	8·043527	18803	11·956473	10·000027	3	9·999973	28	22
39	36	8·054781	18325	11·945219	8·054809	18327	11·945191	10·000028	1	9·999972	24	21
40	40	8·065776	17872	11·934224	8·065806	17875	11·934194	10·000029	3	9·999971	20	20
41	44	8·076500	17441	11·923500	8·076531	17444	11·923469	10·000031	1	9·999969	16	19
42	48	8·086965	17031	11·913035	8·086997	17034	11·913003	10·000032	3	9·999968	12	18
43	52	8·097183	16639	11·902817	8·097217	16642	11·902783	10·000034	3	9·999966	8	17
44	56	8·107167	16265	11·892833	8·107202	16268	11·892798	10·000036	1	9·999964	4	16
45	3	8·116926	15908	11·883074	8·116963	15911	11·883037	10·000037	3	9·999963	57	15
46	4	8·126471	15566	11·873529	8·126510	15568	11·873490	10·000039	3	9·999961	56	14
47	8	8·135810	15238	11·864190	8·135851	15241	11·864149	10·000041	1	9·999959	52	13
48	12	8·144953	14924	11·855047	8·144996	14927	11·855004	10·000042	3	9·999958	48	12
49	16	8·153907	14622	11·846093	8·153952	14625	11·846048	10·000044	3	9·999956	44	11
50	20	8·162681	14333	11·837319	8·162727	14336	11·837273	10·000046	3	9·999954	40	10
51	24	8·171280	14054	11·828720	8·171328	14057	11·828672	10·000048	3	9·999952	36	9
52	28	8·179713	13786	11·820287	8·179763	13790	11·820237	10·000050	3	9·999950	32	8
53	32	8·187985	13529	11·812015	8·188036	13532	11·811964	10·000052	3	9·999948	28	7
54	36	8·196102	13280	11·803898	8·196156	13284	11.803844	10·000054	3	9.999946	24	6
55	40	8·204070	13041	11·795930	8·204126	13044	11·795874	10·000056	3	9·999944	20	5
56	44	8·211895	12810	11·788105	8·211953	12814	11·788047	10·000058	3	9·999942	16	4
57	48	8·219581	12587	11·780419	8·219641	12591	11·780359	10·000060	3	9·999940	12	3
58	52	8·227134	12372	11·772866	8·227195	12376	11·772805	10·000062	3	9·999938	8	2
59	56	8·234557	12164	11·765443	8·234621	12168	11·765379	10·000064	3	9·999936	4	1
60	4	8·241855		11·758145	8·341922		11·758078	10·000066		9·999934	0	0
′		Co-sine.		Secant.	Co-tang.		Tangent.	Co-secant.		Sine.	s m	′

89 Degrees. 5 h. 56m.

TABLE 5.

Logarithmic Sines, Tangents, and Secants.

0h. 36m. 9 Degrees.

′	m s	Sine.	Diff.	Co-secant.	Tangent.	Diff.	Co-tang.	Secant.	D.	Co-sine.		′
0	0	9·194332	1328	10·805668	9·199713	1361	10·800287	10·005380	33	9·994620	24	60
1	4	9·195129	1326	10·804871	9·200529	1359	10·799471	10·005400	33	9·994600	56	59
2	8	9·195925	1323	10·804075	9·201345	1356	10·798655	10.005420	33	9·994580	52	58
3	12	9·196719	1321	10·803281	9·202159	1354	10·797841	10·005440	33	9·994560	48	57
4	16	9·197511	1318	10·802489	9·202971	1352	10·797029	10·005460	35	9·994540	44	56
5	20	9·198302	1316	10·801698	9·203782	1349	10·796218	10·005481	33	9·994519	40	55
6	24	9·199091	1313	10·800909	9·204592	1347	10·795408	10·005501	33	9·994499	36	54
7	28	9·199879	1311	10·800121	9·205400	1345	10·794600	10·005521	33	9·994479	32	53
8	32	9·200666	1308	10·799334	9·206207	1342	10·793793	10·005541	35	9·994459	28	52
9	36	9·201451	1306	10·798549	9·207013	1340	10·792987	10·005562	33	9·994438	24	51
10	40	9·202234	1304	10·797766	9·207817	1338	10·792183	10·005582	33	9·994418	20	50
11	44	9·203017	1301	10·796983	9·208619	1335	10·791381	10·005602	35	9·994398	16	49
12	48	9·203797	1299	10·796203	9·209420	1333	10·790580	10·005623	33	9·994377	12	48
13	52	9·204577	1296	10·795423	9·210220	1331	10·789780	10·005643	35	9·994357	8	47
14	56	9·205354	1294	10·794646	9·211018	1328	10·788982	10·005664	33	9·994336	4	46
15	37	9·206131	1292	10·793869	9·211815	1326	10·788185	10·005684	35	9·994316	23	45
16	4	9·206906	1289	10·793094	9·212611	1324	10·787389	10·005705	35	9·994295	56	44
17	8	9·207679	1287	10·792321	9·213405	1321	10·786595	10·005726	33	9·994274	52	43
18	12	9·208452	1285	10·791548	9·214198	1319	10·785802	10·005746	35	9·994254	48	42
19	16	9·209222	1282	10·790778	9·214989	1317	10·785011	10·005767	35	9·994233	44	41
20	20	9·209992	1280	10·790008	9·215780	1315	10·784220	10·005788	35	9·994212	40	40
21	24	9·210760	1278	10·789240	9·216568	1312	10·783432	10·005809	33	9·994191	36	39
22	28	9·211526	1275	10·788474	9·217356	1310	10·782644	10·005829	35	9·994171	32	38
23	32	9·212291	1273	10·787709	9·218142	1308	10·781858	10·005850	35	9·994150	28	37
24	36	9·213055	1271	10·786945	9·218926	1305	10·781074	10·005871	35	9·994129	24	36
25	40	9·213818	1268	10·786182	9·219710	1303	10·780290	10·005892	35	9·994108	20	35
26	44	9·214579	1266	10·785421	9·220492	1301	10·779508	10·005913	35	9·994087	16	34
27	48	9·215338	1264	10·784662	9·221272	1299	10·778728	10·005934	35	9·994066	12	33
28	52	9·216097	1261	10·783903	9·222052	1297	10·777948	10.005955	35	9·994045	8	32
29	56	9·216854	1259	10·783146	9·222830	1294	10·777170	10·005976	35	9·994024	4	31
30	38	9·217609	1257	10·782391	9·223607	1292	10·776393	10·005997	35	9·994003	22	30
31	4	9·218363	1255	10·781637	9·224382	1290	10·775618	10·006018	37	9·993982	56	29
32	8	9·219116	1253	10·780884	9·225156	1288	10·774844	10·006040	35	9·993960	52	28
33	12	9·219868	1250	10·780132	9·225929	1286	10·774071	10·006061	35	9·993939	48	27
34	16	9·220618	1248	10·779382	9·226700	1284	10·773300	10·006082	35	9·993918	44	26
35	20	9·221367	1246	10·778633	9·227471	1281	10·772529	10·006103	37	9·993897	40	25
36	24	9·222115	1244	10·777885	9·228239	1279	10·771761	10·006125	35	9·993875	36	24
37	28	9·222861	1242	10·777139	9·229007	1277	10·770993	10·006146	37	9·993854	32	23
38	32	9·223606	1239	10·776394	9·229773	1275	10·770227	10·006168	35	9·993832	28	22
39	36	9·224349	1237	10·775651	9·230539	1273	10·769461	10·006189	37	9·993811	24	21
40	40	9·225092	1235	10·774908	9·231302	1271	10·768698	10·006211	35	9·993789	20	20
41	44	9·225833	1233	10·774167	9·232065	1269	10·767935	10·006232	37	9 993768	16	19
42	48	9·226573	1231	10·773427	9·232826	1267	10·767174	10·006254	35	9·993746	12	18
43	52	9·227311	1228	10·772689	9·233586	1265	10·766414	10·006275	37	9·993725	8	17
44	56	9·228048	1226	10·771952	9·234345	1262	10·765655	10·006297	37	9·993703	4	16
45	39	9·228784	1224	10·771216	9·235103	1260	10·764897	10·006319	35	9·993681	21	15
46	4	9·229518	1222	10·770482	9·235859	1258	10·764141	10·006340	37	9·993660	56	14
47	8	9·230252	1220	10·769748	9·236614	1256	10·763386	10·006362	37	9·993638	52	13
48	12	9·230984	1218	10·769016	9·237368	1254	10·762632	10·006384	37	9·993616	48	12
49	16	9·231715	1216	10·768285	9·238120	125 2	10·761880	10·006406	37	9·993594	44	11
50	20	9·232444	1214	10·767556	9·238872	1250	10·761128	10·006428	37	9·993572	40	10
51	24	9·233172	1212	10·766828	9·239622	1248	10·760378	10·006450	37	9·993550	36	9
52	28	9·233899	1209	10·766101	9·240371	1246	10·759629	10·006472	37	9·993528	32	8
53	32	9·234625	1207	10·765375	9·241118	1244	10·758882	10·006494	37	9·993506	28	7
54	36	9·235349	1205	10·764651	9·241865	1242	10·758135	10·006516	37	9·993484	24	6
55	40	9·236073	1203	10·763927	9·242610	1240	10·757390	10·006538	37	9·993462	20	5
56	44	9·236795	1201	10·763205	9·243354	1238	10·756646	10·006560	37	9·993440	16	4
57	48	9 237515	1199	10·762485	9·244097	1236	10·755903	10·006582	37	9·993418	12	3
58	52	9·238235	1197	10·761765	9·244839	1234	10·755161	10·006604	37	9·993396	8	2
59	56	9·238953	1195	10·761047	9·245579	1232	10·754421	10·006626	38	9·993374	4	1
60	40	9·239670		10·760330	9·246319		10·753681	10·006649		9·993351	0	0
′		Co-sine.		Secant.	Co-tang.		Tangent.	Co-secant.		Sine.	m	′

80 Degrees. 5h. 20m.

TABLE 5.

Logarithmic Sines, Tangents, and Secants.

0h. 40m. 10 Degrees.

′	m s	Sine.	Diff.	Co-secant.	Tangent.	Diff.	Co-tang.	Secant.	D.	Co-sine.	s m	′
0	0	9·239670	1193	10·760330	9·246319	1230	10·753681	10·006649	37	9·993351	20	60
1	4	9·240386	1191	10·759614	9·247057	1228	10·752943	10·006671	37	9·993329	56	59
2	8	9·241101	1189	10·758899	9·247794	1226	10·752206	10·006693	38	9·993307	52	58
3	12	9·241814	1187	10·758186	9·248530	1224	10·751470	10·006715	37	9·993285	48	57
4	16	9·242526	1185	10·757474	9·249264	1222	10·750736	10·006738	37	9·993262	44	56
5	20	9·243237	1183	10·756763	9·249998	1220	10·750002	10·006760	38	9·993240	40	55
6	24	9·243947	1181	10·756053	9·250730	1218	10·749270	10·006783	37	9·993217	36	54
7	28	9·244656	1179	10·755344	9·251461	1217	10·748539	10·006805	38	9·993195	32	53
8	32	9·245363	1177	10·754637	9·252191	1215	10·747809	10·006828	38	9·993172	28	52
9	36	9·246069	1175	10·753931	9·252920	1213	10·747080	10·006851	37	9·993149	24	51
10	40	9·246775	1173	10·753225	9·253648	1211	10·746352	10·006873	38	9·993127	20	50
11	44	9·247478	1171	10·752522	9·254374	1209	10. 745626	10·006896	38	9·993104	16	49
12	48	9·248181	1169	10·751819	9·255100	1207	10·744900	10·006919	37	9·993081	12	48
13	52	9·248883	1167	10·751117	9·255824	1205	10·744176	10·006941	38	9·993059	8	47
14	56	9·249583	1165	10·750417	9·256547	1203	10·743453	10·006964	38	9·993036	4	46
15	41	9·250282	1163	10·749718	9·257269	1201	10·742731	10·006987	38	9·993013	19	45
16	4	9·250980	1161	10·749020	9·257990	1200	10·742010	10·007010	38	9·992990	56	44
17	8	9·251677	1159	10·748323	9·258710	1198	10·741290	10·007033	38	9·992967	52	43
18	12	9·252373	1158	10·747627	9·259429	1196	10·740571	10·007056	38	9·992944	48	42
19	16	9·253067	1156	10·746933	9·260146	1194	10·739854	10·007079	38	9·992921	44	41
20	20	9·253761	1154	10·746239	9·260863	1192	10·739137	10·007102	38	9·992898	40	40
21	24	9·254453	1152	10·745547	9·261578	1190	10·738422	10·007125	38	9·992875	36	39
22	28	9·255144	1150	10·744856	9·262292	1189	10·737708	10·007148	38	9·992852	32	38
23	32	9·255834	1148	10·744166	9·263005	1187	10·736995	10·007171	38	9·992829	28	37
24	36	9·256523	1146	10·743477	9·263717	1185	10·736283	10·007194	38	9·992806	24	36
25	40	9 257211	1144	10·742789	9·264428	1183	10·735572	10·007217	40	9·992783	20	35
26	44	9·257898	1142	10·742102	9·265138	1181	10·734862	10·007241	38	9·992759	16	34
27	48	9·258583	1141	10·741417	9·265847	1179	10·734153	10·007264	38	9·992736	12	33
28	52	9·259268	1139	10·740732	9·266555	1178	10·733445	10·007287	38	9·992713	8	32
29	56	9·259951	1137	10·740049	9·267261	1176	10·732739	10·007311	40	9·992690	4	31
30	42	9·260633	1135	10·739367	9·267967	1174	10·732033	10·007334	38	9·992666	18	30
31	4	9·261314	1133	10·738686	9·268671	1172	10·731329	10·007357	40	9·992643	56	29
32	8	9·261994	1131	10·738006	9·269375	1170	10·730625	10·007381	38	9·992619	52	28
33	12	9·262673	1130	10·737327	9·270077	1169	10·729923	10·007404	40	9·992596	48	27
34	16	9·263351	1128	10·736649	9·270779	1167	10·729221	10·007428	38	9·992572	44	26
35	20	9·264027	1126	10·735973	9·271479	1165	10·728521	10·007451	40	9·992549	40	25
36	24	9·264703	1124	10·735297	9·272178	1164	10·727822	10·007475	40	9·992525	36	24
37	28	9·265377	1122	10·734623	9·272876	1162	10·727124	10·007499	38	9·992501	32	23
38	32	9·266051	1120	10·733949	9·273573	1160	10·726427	10·007522	40	9·992478	28	22
39	36	9·266723	1119	10·733277	9·274269	1158	10·725731	10·007546	40	9·992454	24	21
40	40	9·267395	1117	10·732605	9·274964	1157	10·725036	10·007570	40	9·992430	20	20
41	44	9·268065	1115	10·731935	9·275658	1155	10·724342	10·007594	40	9·992406	16	19
42	48	9·268734	1113	10·731266	9·276351	1153	10·723649	10·007618	38	9·992382	12	18
43	52	9·269402	1111	10·730598	9·277043	1151	10·722957	10·007642	40	9·992358	8	17
44	56	9·270069	1110	10·729931	9·277734	1150	10·722266	10·007665	40	9·992335	4	16
45	43	9·270735	1108	10·729265	9·278424	1148	10·721576	10·007689	40	9·992311	17	15
46	4	9·271400	1106	10·728600	9·279113	1146	10·720887	10·007713	40	9·992287	56	14
47	8	9·272064	1105	10·727936	9·279801	1145	10·720199	10·007737	40	9·992263	52	13
48	12	9·272726	1103	10·727274	9·280488	1143	10·719512	10·007761	42	9·992239	48	12
49	16	9·273388	1101	10·726612	9·281174	1141	10·718826	10·007786	40	9·992214	44	11
50	20	9·274049	1099	10·725951	9·281858	1140	10·718142	10·007810	40	9·992190	40	10
51	24	[illegible]	1098	10·725292	9·282542	1138	10·717458	10·007834	40	9·992166	36	9
52	28	[illegible]	1096	10·724633	9·283225	1136	10·716775	10·007858	40	9·992142	32	8
53	32	[illegible]	1094	10·723975	9·283907	1135	10·716093	10·007882	42	9·992118	28	7
54	36	[illegible]	1092	10·723319	9·284588	1133	10·715412	10·007907	40	9·992093	24	6
55	40	[illegible]	1091	10·722663	9·285268	1131	10·714732	10·007931	42	9·992069	20	5
56	44	[illegible]	1090	10·722009	9·285947	1130	10·714053	10·007956	40	9 992044	16	4
57	48	[illegible]	1087	10·721355	9·286624	1128	10·713376	10·007980	40	9·992020	12	3
58	52	[illegible]	1086	10·720703	9·287301	1126	10·712699	10·008004	42	9·991996	8	2
59	56	[illegible]	1084	10·720052	9·287977	1125	10·712023	10·008029	40	9·991971	4	1
60	44	[illegible]		10·719401	9·288652		10·711348	10 008053		9·991947	0	0
		Co-sine.		Secant.	Co-tang.		Tangent.	Co-secant.		Sine.	s m	′

79 Degrees. 5h. 16m.

TABLE 5.

Logarithmic Sines, Tangents, and Secants.

0h. 44m. 11 Degrees.

′	m s	Sine.	Diff.	Co-secant.	Tangent.	Diff.	Co-tang.	Secant.	D.	Co-sine.
0	0	9·280599	1082	10·719401	9·288652	1123	10·711348	10·008053	42	9·991947
1	4	9·281248	1081	10·718752	9·289326	1122	10·710674	10·008078	42	9·991922
2	8	9·281897	1079	10·718103	9·289999	1120	10·710001	10·008103	40	9·991897
3	12	9·282544	1077	10·717456	9·290671	1118	10·709329	10·008127	42	9·991873
4	16	9·283190	1076	10·716810	9·291342	1117	10·708658	10·008152	42	9·991848
5	20	9·283836	1074	10·716164	9·292013	1115	10·707987	10·008177	40	9·991823
6	24	9·284480	1072	10·715520	9·292682	1114	10·707318	10·008201	42	9·991799
7	28	9·285124	1071	10·714876	9·293350	1112	10·706650	10·008226	42	9·991774
8	32	9·285766	1069	10·714234	9·294017	1111	10·705983	10·008251	42	9·991749
9	36	9·286408	1067	10·713592	9·294684	1109	10·705316	10·008276	42	9·991724
10	40	9·287048	1066	10·712952	9·295349	1107	10·704651	10·008301	42	9·991699
11	44	9·287688	1064	10·712312	9·296013	1106	10·703987	10·008326	42	9·991674
12	48	9·288326	1063	10·711674	9·296677	1104	10·703323	10·008351	42	9·991649
13	52	9·288964	1061	10·711036	9·297339	1103	10·702661	10·008376	42	9·991624
14	56	9·289600	1059	10·710400	9·298001	1101	10·701999	10·008401	42	9·991599
15	45	9·290236	1058	10·709764	9·298662	1100	10·701338	10·008426	42	9·991574
16	4	9·290870	1056	10·709130	9·299322	1098	10·700678	10·008451	42	9·991549
17	8	9·291504	1054	10·708496	9·299980	1096	10·700020	10·008476	43	9·991524
18	12	9·292137	1053	10·707863	9·300638	1095	10·699362	10·008502	42	9·991498
19	16	9·292768	1051	10·707232	9·301295	1093	10·698705	10·008527	42	9·991473
20	20	9·293399	1050	10·706601	9·301951	1092	10·698049	10·008552	43	9·991448
21	24	9·294029	1048	10·705971	9·302607	1090	10·697393	10·008578	42	9·991422
22	28	9·294658	1046	10·705342	9·303261	1089	10·696739	10·008603	42	9·991397
23	32	9·295286	1045	10·704714	2·303914	1087	10·696086	10·008628	43	9·991372
24	36	9·295913	1043	10·704087	9·304567	1086	10·695433	10·008654	42	9·991346
25	40	9·296539	1042	10·703461	9·305218	1084	10·694782	10·008679	43	9·991321
26	44	9·297164	1040	10·702836	9·305869	1083	10·694131	10·008705	42	9·991295
27	48	9·297788	1039	10·702212	9·306519	1081	10·693481	10·008730	43	9·991270
28	52	9·298412	1037	10·701588	9·307168	1080	10·692832	10·008756	43	9·991244
29	56	9·299034	1036	10·700966	9·307815	1078	10·692185	10·008782	42	9·991218
30	46	9·299655	1034	10·700345	9·308463	1077	10·691537	10·008807	43	9·991193
31	4	9·300276	1032	10·699724	9·309109	1075	10·690891	10·008833	43	9·991167
32	8	9·300895	1031	10·699105	9·309754	1074	10·690246	10·008859	43	9·991141
33	12	9·301514	1029	10·698486	9·310398	1073	10·689602	10·008885	42	9·991115
34	16	9·302132	1028	10·697868	9·311042	1071	10·688958	10·008910	43	9·991090
35	20	9·302748	1026	10·697252	9·311685	1070	10·688315	10·008936	43	9·991064
36	24	9·303364	1025	10·696636	9·312327	1068	10·687673	10·008962	43	9·991038
37	28	9·303979	1023	10·696021	9·312967	1067	10·687033	10·008988	43	9·991012
38	32	9·304593	1022	10·695407	9·313608	1065	10·686392	10·009014	43	9·990986
39	36	9·305207	1020	10·694793	9·314247	1064	10·685753	10·009040	43	9·990960
40	40	9·305819	1019	10·694181	9·314885	1062	10·685115	10·009066	43	9·990934
41	44	9·306430	1017	10·693570	9·315523	1061	10·684477	10·009092	43	9·990908
42	48	9·307041	1016	10·692959	9·316159	1060	10·683841	10·009118	45	9·990882
43	52	9·307650	1014	10·692350	9·316795	1058	10·683205	10·009145	43	9·990855
44	56	9·308259	1013	10·691741	9·317430	1057	10·682570	10·009171	43	9·990829
45	47	9·308867	1011	10·691133	9·318064	1055	10·681936	10·009197	43	9·990803
46	4	9·309474	1010	10·690526	9·318697	1054	10·681303	10·009223	45	9·990777
47	8	9·310080	1008	10·689920	9·319329	1053	10·680671	10·009250	43	9·990750
48	12	9·310685	1007	10·689315	9·319961	1051	10·680039	10·009276	45	9·990724
49	16	9·311289	1006	10·688711	9·320592	1050	10·679408	10·009303	43	9·990697
50	20	9·311893	1004	10·688107	9·321222	1048	10·678778	10·009329	43	9·990671
51	24	9·312495	1003	10·687505	9·321851	1047	10·678149	10·009355	45	9·990645
52	28	9·313097	1001	10·686903	9·322479	1045	10·677521	10·009382	45	9·990618
53	32	9·313698	1000	10·686302	9·323106	1044	10·676894	10·009409	43	9·990591
54	36	9·314297	998	10·685703	9·323733	1043	10·676267	10·009435	45	9·990565
55	40	9·314897	997	10·685103	9·324358	1041	10·675642	10·009462	45	9·990538
56	44	9·315495	996	10·684505	9·324983	1040	10·675017	10·009489	43	9·990511
57	48	9·316092	994	10·683908	9·325607	1039	10·674393	10·009515	45	9·990485
58	52	9·316689	993	10·683311	9 326231	1037	10·673769	10·009542	45	9·990458
59	56	9·317284	991	10·682716	9·326853	1036	10·673147	10·009569	45	9·990431
60	48	9·317879		10·682121	9·327475		10·672525	10·009596		9·990404
′		Co-sine.		Secantt	Co-tang.		Tangent.	Co-secant.		Sine.

TABLE 5.

Logarithmic Sines, Tangents, and Secants.

0h. 16m. 4 Degrees.

′	m s	Sine.	Diff.	Co-secant.	Tangent.	Diff.	Co-tang.	Secant.	D.	Co-sine.		′
0	0	8·843585	3005	11·156415	8·844644	3019	11·155356	10·001059	15	9·998941	**44**	60
1	4	8·845387	2992	11·154613	8·846455	3007	11·153545	10·001068	15	9·998932	56	59
2	8	8·847133	2980	11·152817	8·848260	2995	11·151740	10·001077	15	9·998923	52	58
3	12	8·848971	2967	11·151029	8·850057	2982	11·149943	10·001086	15	9·998914	48	57
4	16	8·850751	2955	11·149249	8·851846	2970	11·148154	10·001095	15	9·998905	44	56
5	20	8·852525	2943	11·147475	8·853628	2958	11·146372	10·001104	15	9·998896	40	55
6	24	8·854291	2931	11·145709	8·855403	2946	11·144597	10·001113	15	9·998887	36	54
7	28	8·856049	2919	11·143951	8·857171	2935	11·142829	10·001122	15	9·998878	32	53
8	32	8·857801	2908	11·142199	8·858932	2923	11·141068	10·001131	15	9·998869	28	52
9	36	8·859546	2896	11·140454	8·860686	2911	11·139314	10·001140	15	9·998860	24	51
10	40	8·861283	2884	11·138717	8·862433	2900	11·137567	10·001149	17	9·998851	20	50
11	44	8·863014	2873	11·136986	8·864173	2888	11·135827	10·001159	15	9·998841	16	49
12	48	8·864738	2861	11·135262	8·865906	2877	11·134094	10·001168	15	9·998832	12	48
13	52	8·866455	2850	11·133545	8·867632	2866	11·132368	10·001177	17	9·998823	8	47
14	56	8·868165	2839	11·131835	8·869351	2854	11·130649	10·001187	15	9·998813	4	46
15	**17**	8·869868	2828	11·130132	8·871064	2843	11·128936	10·001196	15	9·998804	**43**	45
16	4	8·871565	2817	11·128435	8·872770	2832	11·127230	10·001205	17	9·998795	56	44
17	8	8·873255	2806	11·126745	8·874469	2821	11·125531	10·001215	15	9·998785	52	43
18	12	8·874938	2795	11·125062	8·876162	2811	11·123838	10·001224	17	9·998776	48	42
19	16	8·876615	2784	11·123385	8·877849	2800	11·122151	10·001234	15	9·998766	44	41
20	20	8·878285	2773	11·121715	8·879529	2789	11·120471	10·001243	17	9·998757	40	40
21	24	8·879949	2763	11·120051	8·881202	2779	11·118798	10·001253	17	9·998747	36	39
22	28	8·881607	2752	11·118393	8·882869	2768	11·117131	10·001262	15	9·998738	32	38
23	32	8·883258	2742	11·116742	8·884530	2758	11·115470	10·001272	17	9·998728	28	37
24	36	8·884903	2731	11·115097	8·886185	2747	11·113815	10·001282	17	9·998718	24	36
25	40	8·886542	2721	11·113458	8·887833	2737	11·112167	10·001292	15	9·998708	20	35
26	44	8·888174	2711	11·111826	8·889476	2727	11·110524	10·001301	17	9·998699	16	34
27	48	8·889801	2700	11·110199	8·891112	2717	11·108888	10·001311	17	9·998689	12	33
28	52	8·891421	2690	11·108579	8·892742	2707	11·107258	10·001321	17	9·998679	8	32
29	56	8·893035	2680	11·106965	8·894366	2697	11·105634	10·001331	17	9·998669	4	31
30	**18**	8·894643	2670	11·105357	8·895984	2687	11·104016	10·001341	17	9·998659	**42**	30
31	4	8·896246	2660	11·103754	8·897596	2677	11·102404	10·001351	17	9·998649	56	29
32	8	8·897842	2651	11·102158	8·899203	2667	11·100797	10·001361	17	9·998639	52	28
33	12	8·899432	2641	11·100568	8·900803	2658	11·099197	10·001371	17	9·998629	48	27
34	16	8·901017	2631	11·098983	8·902398	2648	11·097602	10·001381	17	9·998619	44	26
35	20	8·902596	2622	11·097404	8·903987	2638	11·096013	10·001391	17	9·998609	40	25
36	24	8·904169	2612	11·095831	8·905570	2629	11·094430	10·001401	17	9·998599	36	24
37	28	8·905736	2603	11·094264	8·907147	2620	11·092853	10·001411	18	9·998589	32	23
38	32	8·907297	2593	11·092703	8·908719	2610	11·091281	10·001422	17	9·998578	28	22
39	36	8·908853	2584	11·091147	8·910285	2601	11·089715	10·001432	17	9·998568	24	21
40	40	8·910404	2575	11·089596	8·911846	2592	11·088154	10·001442	17	9·998558	20	20
41	44	8·911949	2566	11·088051	8·913401	2583	11·086599	10·001452	18	9·998548	16	19
42	48	8·913488	2556	11·086512	8·914951	2574	11·085049	10·001463	17	9·998537	12	18
43	52	8·915022	2547	11·084978	8·916495	2565	11·083505	10·001473	18	9·998527	8	17
44	56	8·916550	2538	11·083450	8·918034	2556	11·081966	10·001484	17	9·998516	4	16
45	**19**	8·918073	2529	11·081927	8·919568	2547	11·080432	10·001494	18	9·998506	**41**	15
46	4	8·919591	2520	11·080409	8·921096	2538	11·078904	10·001505	17	9·998495	56	14
47	8	8·921103	2512	11·078897	8·922619	2530	11·077381	10·001515	18	9·998485	52	13
48	12	8·922610	2503	11·077390	8·924136	2521	11·075864	10·001526	17	9·998474	48	12
49	16	8·924112	2494	11·075888	8·925649	2512	11·074351	10·001536	18	9·998464	44	11
50	20	8·925609	2486	11·074391	8·927156	2503	11·072844	10·001547	18	9·998453	40	10
51	24	8·927100	2477	11·072900	8·928658	2495	11·071342	10·001558	18	9·998442	36	9
52	28	8·928587	2469	11·071413	8·930155	2486	11·069845	10·001569	17	9·998431	32	8
53	32	8·930068	2460	11·069932	8·931647	2478	11·068353	10·001579	18	9·998421	28	7
54	36	8·931544	2452	11·068456	8·933134	2470	11·066866	10·001590	18	9·998410	24	6
55	40	8·933015	2443	11·066985	8·934616	2461	11·065384	10·001601	18	9·998399	20	5
56	44	8·934481	2435	11·065519	8·936093	2453	11·063907	10·001612	18	9·998388	16	4
57	48	8·935842	2427	11·064058	8·937565	2445	11·062435	10·001623	18	9·998377	12	3
58	52	8·937398	2419	11·062602	8·939032	2437	11·060968	10·001634	18	9·998366	8	2
59	56	8·938850	2411	11·061150	8·940494	2429	11·059506	10·001645	18	9·998355	4	1
60	**20**	8·940296		11·059704	8·941952		11·058048	10·001656		9·998344	0	0
′		Co-sine.		Secant.	Co-tang.		Tangent.	Co-secant.		Sine.	s m	′

85 Degrees. 5h. 40m.

TABLE 5.
Logarithmic Sines,Tangents, and Secants.

0h. 52m. 13 Degrees.

′	m s	Sine.	Diff.	Co-secant.	Tangent.	Diff.	Co-tang.	Secant.	D.	Co-sine.		′
0	0	9·352088	911	10·647912	9·363364	960	10·636636	10·011276	48	9·988724	8	60
1	4	9·352635	910	10·647365	9·363940	959	10·636060	10·011305	48	9·988695	56	59
2	8	9·353181	909	10·646819	9·364515	958	10·635485	10·011334	50	9·988666	52	58
3	12	9·353726	908	10·646274	9·365090	957	10·634910	10·011364	48	9·988636	48	57
4	16	9·354271	907	10·645729	9·365664	955	10·634336	10·011393	48	9·988607	44	56
5	20	9·354815	905	10·645185	9·366237	954	10·633763	10·011422	50	9·988578	40	55
6	24	9·355358	904	10·644642	9·366810	953	10·633190	10·011452	48	9·988548	36	54
7	28	9·355901	903	10·644099	9·367382	952	10·632618	10·011481	50	9·988519	32	53
8	32	9·356443	902	10·643557	9·367953	951	10·632047	10·011511	48	9·988489	28	52
9	36	9·356984	901	10·643016	9·368524	950	10·631476	10·011540	50	9·988460	24	51
10	40	9·357524	899	10·642476	9·369094	949	10·630906	10·011570	48	9·988430	20	50
11	44	9·358064	898	10·641936	9·369663	948	10·630337	10·011599	50	9·988401	16	49
12	48	9·358603	897	10·641397	9·370232	946	10·629768	10·011629	48	9·988371	12	48
13	52	9·359141	896	10·640859	9·370799	945	10·629201	10·011658	50	9·988342	8	47
14	56	9·359678	895	10·640322	9·371367	944	10·628633	10·011688	50	9·988312	4	46
15	53	9·360215	853	10·639785	9·371933	943	10·628067	10·011718	50	9·988282	7	45
16	4	9·360752	892	10·639248	9·372499	942	10·627501	10·011748	48	9·988252	56	44
17	8	9·361287	891	10·638713	9·373064	941	10·626936	10·011777	50	9·988223	52	43
18	12	9·361822	890	10·638178	9·373629	940	10·626371	10·011807	50	9·988193	48	42
19	16	9·362356	889	10·637644	9·374193	939	10·625807	10·011837	50	9·988163	44	41
20	20	9·362889	888	10·637111	9·374756	938	10·625244	10·011867	50	9·988133	40	40
21	24	9·363422	887	10·636578	9·375319	937	10·624681	10·011897	50′	9·988103	36	39
22	28	9·363954	885	10·636046	9·375881	935	10·624119	10·011927	50	9·988073	32	38
23	32	9·364485	884	10·635515	9·376442	934	10·623558	10·011957	50	9·988043	28	37
24	36	9·365016	883	10·634984	9·377003	933	10·622997	10·011987	50	9·988013	24	36
25	40	9 365546	882	10·634454	9·377563	932	10·622437	10·012017	50	9·987983	20	35
26	44	9·366075	881	10·633925	9·378122	931	10·621878	10·012047	52	9·987953	16	34
27	48	9·366604	880	10·633396	9·378681	930	10·621319	10·012078	50	9·987922	12	33
28	52	9·367131	879	10·632869	9·379239	929	10·620761	10·012108	50	9·987892	8	32
29	56	9·367659	878	10·632341	9·379797	928	10·620203	10·012138	50	9·987862	4	31
30	54	9·368185	876	10·631815	9·380354	927	10·619646	10·012168	52	9·987832	6	30
31	4	9·368711	875	10·631289	9·380910	926	10·619090	10·012199	50	9·987801	56	29
32	8	9·369236	874	10·630764	9·381466	925	10·618534	10·012229	52	9·987771	52	28
33	12	9·369761	873	10·630239	9·382020	924	10·617980	10·012260	50	9·987740	48	27
34	16	9·370285	872	10·629715	9·382575	923	10·617425	10·012290	52	9·987710	44	26
35	20	9·370808	871	10·629192	9·383129	922	10·616871	10·012321	50	9·987679	40	25
36	24	9·371330	870	10·628670	9·383682	921	10·616318	10·012351	52	9·987649	36	24
37	28	9·371852	869	10·628148	9·384234	920	10·615766	10·012382	50	9·987618	32	23
38	32	9·372373	867	10·627627	9·384786	919	10·615214	10·012412	52	9·987588	28	22
39	36	9·372894	866	10·627106	9·385337	918	10·614663	10·012443	52	9·987557	24	21
40	40	9·373414	865	10·626586	9·385888	917	10·614112	10·012474	50	9·987526	20	20
41	44	9·373933	864	10·626067	9·386438	916	10·613562	10·012504	52	9·987496	16	19
42	48	9·374452	863	10·625548	9·386987	914	10·613013	10·012535	52	9·987485	12	18
43	52	9·374970	862	10·625030	9·387536	913	10·612464	10·012566	52	9·987434	8	17
44	56	9·375487	861	10·624513	9·388084	912	10·611916	10·012597	52	9·987403	4	16
45	55	9·376003	860	10·623997	9.388631	911	10·611369	10·012628	52	9·987372	5	15
46	4	9·376519	859	10·623481	9·389178	910	10·610822	10·012659	52	9·987341	56	14
47	8	9·377035	858	10·622965	9·389724	909	10·610276	10·012690	52	9·987310	52	13
	12	9·377549	857	10·622451	9·390270	908	10·609730	10·012721	52	9·987279	48	12
	16	9·378063	856	10·621937	9·390815	907	10·609185	10·012752	52	9·987248	44	11
	20	9·378577	854	10·621423	9·391360	906	10·608640	10·012783	52	9·987217	40	10
	24	9·379089	853	10·620911	9·391903	905	10·608097	10·012814	52	9·987186	36	9
	28	9·379601	852	10·620399	9·392447	904	10·607553	10·012845	52	9·987155	32	8
	32	9·380113	851	10·619887	9·392989	903	10·607011	10·012876	53	9·987124	28	7
	36	9·380624	850	10·619376	9·393531	902	10·606469	10·012908	52	9·987092	24	6
	40	9 381134	849	10·618866	9·394073	901	10·605927	10·012939	52	9·987061	20	5
	44	9·381643	848	10·618357	9·394614	900	10·605386	10·012970	53	9·987030	16	4
	48	9·382152	847	10·617848	9·395154	899	10·604846	10·013002	52	9·986998	12	3
	52	9·382661	846	10·617339	9·395694	898	10·604306	10·013033	52	9·986967	8	2
	56	9.383168	845	10·616832	9·396233	897	10·603767	10·013064	53	9·986936	4	1
	56	9·383675		10·616325	9·396771		10·603229	10·013096		9·986904	0	0
		Co-sine.		Secant.	Co-tang.		Tangent.	Co-secant.		Sine.	s m	′

76 Degrees.

TABLE 5.

Logarithmic Sines, Tangents, and Secants.

0h. 56m. 14 Degrees.

′	m s	Sine.	Diff.	Co-secant.	Tangent.	Diff.	Co-tang.	Secant.	D.	Co-sine.		′
0	6	9·383675	844	10·616325	9·396771	896	10·603229	10.013096	52	9·986904	4	60
1	4	9·384182	843	10·615818	9·397309	896	10·602691	10.013127	53	9·986873	56	59
2	8	9·384687	842	10·615313	9·397846	895	10·602154	10.013159	53	9·986841	52	58
3	12	9·385192	841	10·614808	9·398383	894	10·601617	10.013191	52	9·986809	48	57
4	16	9·385697	840	10·614303	9·398919	893	10·601081	10.013222	53	9·986778	44	56
5	20	9·386201	839	10·613799	9·399455	892	10·600545	10·013254	53	9 986746	40	55
6	24	9·386704	828	10·613296	9·399990	891	10·600010	10·013286	52	9·986714	36	54
7	28	9·387207	837	10·612793	9·400524	890	10·599476	10·013317	53	9·986683	32	53
8	32	9·387709	836	10·612291	9·401058	889	10·598942	10·013349	53	9·986651	28	52
9	36	9·388210	835	10·611790	9·401591	888	10·598409	10·013381	53	9·986619	24	51
10	40	9·388711	834	10·611289	9·402124	887	10·597876	10·013413	53	9·986587	20	50
11	44	9·389211	833	10·610789	9·402656	886	10·597344	10·013445	53	9·986555	16	49
12	48	9·389711	832	10·610289	9·403187	885	10·596813	10·013477	53	9·986523	12	48
13	52	9·390210	831	10·609790	9·403718	884	10·596282	10·013509	53	9·986491	8	47
14	56	9·390708	830	10·609292	9·404249	883	10·595751	10·013541	53	9·986459	4	46
15	57	9·391206	838	10·608794	9·404778	882	10·595222	10·013573	53	9·986427	3	45
16	4	9·391703	827	10·608297	9·405308	881	10·594692	10·013605	53	9·986395	56	44
17	8	9·392199	826	10·607801	9·405836	880	10·594164	10·013637	53	9·986363	52	43
18	12	9·392695	825	10·607305	9·406364	879	10·593636	10·013669	53	9·986331	48	42
19	16	9·393191	824	10·606810	9·406892	878	10·593108	10·013701	55	9·986299	44	41
20	20	9·393685	823	10·606315	9·407419	877	10·592581	10·013734	53	9·986266	40	40
21	24	9·394179	822	10·605821	9·407945	876	10·592055	10·013766	53	9·986234	36	39
22	28	9·394673	821	10·605327	9·408471	875	10·591529	10·013798	55	9·986202	32	38
23	32	9·395166	820	10·604834	9·408997	874	10·591003	10·013831	53	9·986169	28	37
24	36	9·395658	819	10·604342	9·409521	874	10·590479	10·013863	55	9·986137	24	36
25	40	9·396150	818	10·603850	9·410045	873	10·589955	10·013896	53	9 986104	20	35
26	44	9·396641	817	10·603359	9·410569	872	10·589431	10·013928	55	9·986072	16	34
27	48	9·397132	817	10·602868	9·411092	871	10·588908	10·013961	53	9·986039	12	33
28	52	9·397621	816	10·602379	9·411615	870	10·588385	10·013993	55	9·986007	8	32
29	56	9·398111	815	10·601889	9·412137	869	10·587863	10·014026	53	9·985974	4	31
30	58	9·398600	814	10·601400	9·412658	868	10·587342	10·014058	55	9·985942	2	30
31	4	9·399088	813	10·600912	9·413179	867	10·586821	10·014091	55	9·985909	56	29
32	8	9·399575	812	10·600425	9·413699	866	10·586301	10·014124	55	9·985876	52	28
33	12	9·400062	811	10·599938	9·414219	865	10·585781	10·014157	53	9·985843	48	27
34	16	9·400549	810	10·599451	9·414738	864	10·585262	10·014189	55	9·985811	44	26
35	20	9·401035	809	10·598965	9·415257	864	10·584743	10·014222	55	9·985778	40	25
36	24	9·401520	808	10·598480	9·415775	863	10·584225	10·014255	55	9·985745	36	24
37	28	9·402005	807	10·597995	9·416293	862	10·583707	10·014288	55	9·985712	32	23
38	32	9·402489	806	10·597511	9·416810	861	10·583190	10·014321	55	9 985679	28	22
39	36	9·402972	805	10·597028	9·417326	860	10·582674	10·014354	55	9·985646	24	21
40	40	9·403455	804	10·596545	9·417842	859	10·582158	10·014387	55	9·985613	20	20
41	44	9·403938	803	10·596062	9·418358	858	10·581642	10·014420	55	9·985580	16	19
42	48	9·404420	802	10·595580	9·418873	857	10·581127	10·014453	55	9·985547	12	18
43	52	9·404901	801	10·595099	9·419387	856	10·580613	10·014486	57	9·985514	8	17
44	56	9·405382	800	10·594618	9·419901	855	10·580099	10·014520	55	9·985480	4	16
45	59	9·405862	799	10·594138	9·420415	855	10·579585	10·014553	55	9·985447	1	15
46	4	9·406341	798	10·593659	9·420927	854	10·579073	10·014586	55	9·985414	56	14
47	8	9·406820	797	10·593180	9·421440	853	10·578560	10·014619	57	9·985381	52	13
48	12	9·407299	796	10·592701	9·421952	852	10·578048	10·014653	55	9·985347	48	12
49	16	9·407777	795	10·592223	9·422463	851	10·577537	10·014686	57	9·985314	44	11
50	20	9·408254	794	10·591746	9·422974	850	10·577026	10·014720	55	9·985280	40	10
51	24	9·408731	794	10·591269	9·423484	849	10·576516	10·014753	57	9·985247	36	9
52	28	9·409207	793	10·590793	9·423993	848	10·576007	10·014787	55	9·985213	32	8
53	32	9·409682	792	10·590318	9·424503	848	10·575497	10·014820	57	9·985180	28	7
54	36	9·410157	791	10·589843	9·425011	847	10·574989	10·014854	55	9·985146	24	6
55	40	9·410632	790	10·589368	9·425519	846	10·574481	10·014887	57	9·985113	20	5
56	44	9·411106	789	10·588894	9·426027	845	10·573973	10·014921	57	9·985079	16	4
57	48	9·411579	788	10·588421	9·426534	844	10·573466	10·014955	57	9·985045	12	3
58	52	9·412052	787	10·587948	9·427041	843	10·572959	10·014989	55	9·985011	8	2
59	56	9·412524	786	10·587476	9·427547	843	10·572453	10·015022	57	9·984978	4	1
60	60	9·412996		10·587004	9·428052		10·571948	10·015056		9·984944	0	0
′		Co-sine.		Secant.	Co-tang.		Tangent.	Co-secant.		Sine.	s m	′

75 Degrees. 5h. 0m.

TABLE 5.

Logarithmic Sines, Tangents, and Secants.

1h. 0m. 15 Degrees.

′	m s	Sine.	Diff.	Co-secant.	Tangent.	Diff.	Co-tang.	Secant.	D.	Co-sine.		
0	0	9·412996	785	10·587004	9·428052	842	10.571948	10·015056	57	9·984944	60	60
1	4	9·413467	784	10·586533	9·428557	841	10·571443	10·015090	57	9 984910	56	59
2	8	9·413938	783	10·586062	9·429062	840	10·570938	10·015124	57	9·984876	52	58
3	12	9·414408	783	10·585592	9·429566	839	10·570434	10·015158	57	9·984842	48	57
4	16	9·414878	782	10·585122	9·430070	838	10·569930	10·015192	57	9·984808	44	56
5	20	9·415347	781	10·584653	9·430573	838	10·569427	10·015226	57	9·984774	40	55
6	24	9·415815	780	10·584185	9·431075	837	10·568925	10·015260	57	9·984740	36	54
7	28	9·416283	779	10·583717	9·431577	836	10·568423	10·015294	57	9·984706	32	53
8	32	9·416751	778	10·583249	9·432079	835	10·567921	10·015328	57	9·984672	28	52
9	36	9·417217	777	10·582783	9·432580	834	10·567420	10·015362	58	9·984638	24	51
10	40	9·417684	776	10·582316	9·433080	833	10·566920	10·015397	57	9·984603	20	50
11	44	9.418150	775	10·581850	9·433580	832	10·566420	10 015431	57	9·984569	16	49
12	48	9.418615	774	10·581385	9·434080	832	10·565920	10·015465	58	9·984535	12	48
13	52	9.419079	773	10·580921	9·434579	831	10·565421	10·015500	57	9·984500	8	47
14	56	9·419544	773	10·580456	9·435078	830	10·564922	10·015534	57	9·984466	4	46
15	1	9·420007	772	10·579993	9·435576	829	10·564424	10·015568	58	9·984432	59	45
16	4	9·420470	771	10·579530	9·436073	828	10·563927	10·015603	57	9·984397	56	44
17	8	9·420933	770	10·579067	9·436570	828	10·563430	10·015637	58	9·984363	52	43
18	12	9·421395	769	10·578605	9·437067	827	10·562933	10·015672	58	9·984328	48	42
19	16	9·421857	768	10·578143	9·437563	826	10·562437	10·015706	57	9·984294	44	41
20	20	9·422318	767	10·577682	9·438059	825	10·561941	10·015741	58	9·984259	40	40
21	24	9·422778	767	10·577222	9·438554	824	10·561446	10·015776	57	9·984224	36	39
22	28	9·423238	766	10·576762	9·439048	823	10·560952	10·015810	58	9·984190	32	38
23	32	9·423697	765	10·576303	9·439543	823	10·560457	10·015845	58	9·984155	28	37
24	36	9·424156	764	10·575844	9·440036	822	10·559964	10·015880	58	9·984120	24	36
25	40	9·424615	763	10·575385	9·440529	821	10·559471	10·015915	58	9·984085	20	35
26	44	9·425073	762	10·574927	9·441022	820	10·558978	10·015950	58	9·984050	16	34
27	48	9·425530	761	10·574470	9·441514	819	10·558486	10·015985	57	9·984015	12	33
28	52	9·425987	760	10·574013	9·442006	819	10·557994	10·016019	58	9·983981	8	32
29	56	9·426443	760	10 573557	9·442497	818	10·557503	10·016054	58	9·983946	4	31
30	2	9·426899	759	10·573101	9·442988	817	10·557012	10·016089	60	9·983911	58	30
31	4	9·427354	758	10·572646	9·443479	816	10·556521	10·016125	58	9·983875	56	29
32	8	9·427809	757	10·572191	9·443968	816	10·556032	10·016160	58	9·983840	52	28
33	12	9·428263	756	10·571737	9·444458	815	10·555542	10·016195	58	9·983805	48	27
34	16	9·428717	755	10·571283	9·444947	814	10·555053	10·016230	58	9·983770	44	26
35	20	9·429170	754	10·570830	9·445435	813	10·554565	10·016265	58	9·983735	40	25
36	24	9·429623	753	10·570377	9·445923	812	10·554077	10·016300	60	9·983700	36	24
37	28	9·430075	752	10·569925	9·446411	812	10·553589	10·016336	58	9·983664	32	23
38	32	9·430527	752	10·569473	9·446898	811	10·553102	10·016371	58	9·983629	28	22
39	36	9·430978	751	10·569022	9·447384	810	10·552616	10·016406	60	9·983594	24	21
40	40	9·431429	750	10·568571	9·447870	809	10·552130	10·016442	58	9·983558	20	20
41	44	9·431879	749	10·568121	9·448356	809	10·551644	10·016477	60	9·983523	16	19
42	48	9·432329	749	10·567671	9·448841	808	10·551159	10·016513	58	9·983487	12	18
43	52	9·432778	748	10·567222	9·449326	807	10·550674	10·016548	60	9·983452	8	17
44	56	9·433226	747	10·566774	9·449810	806	10·550190	10·016584	58	9·983416	4	16
45	3	9·433675	746	10·566325	9·450294	806	10·549706	10·016619	60	9·983381	57	15
46	4	9·434122	745	10·565878	9·450777	805	10·549223	10·016655	60	9·983345	56	14
47	8	9·434569	744	10·565431	9·451260	804	10·548740	10·016691	60	9·983309	52	13
48	12	9·435016	744	10·564984	9·451743	803	10·548257	10·016727	58	9·983273	48	12
49	16	9·435462	743	10·564538	9·452225	802	10·547775	10·016762	60	9·983238	44	11
50	20	9·435908	742	10·564092	9·452706	802	10·547294	10·016798	60	9·983202	40	10
51	24	9·436353	741	10·563647	9·453187	801	10·546813	10·016834	60	9·983166	36	9
52	28	9·436798	740	10·563202	9·453668	800	10·546332	10·016870	60	9·983130	32	8
53	32	9·437242	740	10·562758	9·454148	799	10·545852	10·016906	60	9·983094	28	7
54	36	9·437686	739	10·562314	9·454628	799	10·545372	10·016942	60	9·983058	24	6
55	40	9·438129	738	10·561871	9·455107	798	10·544893	10·016978	60	9·983022	20	5
56	44	9·438572	737	10·561428	9·455586	797	10·544414	10·017014	60	9·982986	16	4
57	48	9·439014	736	10·560986	9·456064	796	10·543936	10·017050	60	9·982950	12	3
58	52	9·439456	786	10·560544	9·456542	796	10·543458	10·017086	60	9·982914	8	2
59	56	9·439897	735	10·560103	9·457019	795	10·542981	10·017122	60	9·982878	4	1
60	4	9·440338		10·559662	9·457496		10·542504	10·017158		9·982842	0	0
′		Co-sine.		Secant.	Co-tang.		Tangent.	Co-secant.		Sine.	s m	′

TABLE 5.

Logarithmic Sines, Tangents, and Secants.

0h. 0m. 0 Degree.

'	m s	Sine.	Diff.	Co-secant.	Tangent.	Diff.	Co.tang.	Secant.	D	Co-sine.		'
0	0	0·000000		Infinite.	0·000000		Infinite.	10·000000	0	10·000000	60	60
1	4	6·463726	501717	13·536274	6·463726	501717	13·536274	10·000000	0	10·000000	56	59
2	8	6·764756	293485	13·235244	6·764756	293485	13·235244	10·000000	0	10·000000	52	58
3	12	6·940847	208231	13·059153	6·940847	208231	13·059153	10·000000	0	10·000000	48	57
4	16	7·065786	161517	12·934214	7·065786	161517	12·934214	10·000000	0	10·000000	44	56
5	20	7·162696	131968	12·837304	7·162696	131969	12·837304	10·000000	0	10·000000	40	55
6	24	7·241877	111578	12·758123	7·241878	111578	12·758122	10·000001	0	9·999999	36	54
7	28	7·308824	96653	12·691176	7·308825	96653	12·691175	10·000001	0	9·999999	32	53
8	32	7·366816	85254	12·633184	7·366817	85254	12·633183	10·000001	0	9·999999	28	52
9	36	7·417968	76262	12·582032	7·417970	76263	12·582030	10·000001	1	9·999999	24	51
10	40	7·463726	68988	12·536274	7·463727	68988	12·536273	10·000002	0	9·999998	20	50
11	44	7·505118	62981	12·494882	7·505120	62981	12·494880	10·000002	1	9·999998	16	49
12	48	7·542906	57936	12·457094	7·542909	57937	12·457091	10·000003	0	9·999997	12	48
13	52	7·577668	53641	12·422332	7·577672	53642	12·422328	10·000003	1	9·999997	8	47
14	56	7·609853	49938	12·390147	7·609857	49939	12·390143	10·000004	0	9·999996	4	46
15	1	7·639816	46714	12·360184	7·639820	46715	12·360180	10·000004	1	9·999996	59	45
16	4	7·667845	43881	12·332155	7·667849	43882	12·332151	10·000005	0	9·999995	56	44
17	8	7·694173	41372	12·305827	7·694179	41373	12·305821	10·000005	1	9·999995	52	43
18	12	7·718997	39135	12·281003	7·719003	39136	12 280997	10·000006	1	9·999994	48	42
19	16	7·742478	37127	12·257522	7·742484	37128	12·257516	10·000007	0	9·999993	44	41
20	20	7·764754	35315	12·235246	7·764761	35315	12·235239	10·000007	1	9·999993	40	40
21	24	7·785943	33672	12·214057	7·785951	33673	12·214049	10·000008	1	9·999992	36	39
22	28	7·806146	32175	12·193854	7·806155	32176	12·193845	10·000009	1	9·999991	32	38
23	32	7·825451	30805	12·174549	7·825460	30807	12·174540	10·000010	1	9·999990	28	37
24	36	7·843934	29547	12·156066	7·843944	29549	12·156056	10·000011	1	9·999989	24	36
25	40	7·861662	28388	12·138338	7·861674	28390	12·138326	10·000011	0	9·999989	20	35
26	44	7·878695	27317	12·121305	7·878708	27318	12·121292	10·000012	1	9·999988	16	34
27	48	7·895085	26323	12·104915	7·895099	26325	12·104901	10·000013	1	9·999987	12	33
28	52	7·910879	25399	12·089121	7·910894	25401	12·089106	10·000014	1	9·999986	8	32
29	56	7·926119	24538	12·073881	7·926134	24540	12·073866	10·000015	1	9·999985	4	31
30	2	7·940842	23733	12·059158	7·940858	23735	12·059142	10·000017	3	9·999983	58	30
31	4	7·955082	22980	12·044918	7·955100	22982	12·044900	10·000018	1	9·999982	56	29
32	8	7·968870	22273	12·031130	7·968889	22275	12·031111	10·000019	1	9·999981	52	28
33	12	7·982233	21608	12·017767	7·982253	21610	12·017747	10·000020	1	9·999980	48	27
34	16	7·995198	20981	12·004802	7·995219	20983	12·004781	10·000021	3	9·999979	44	26
35	20	8·007787	20390	11·992213	8 007809	20392	11·992191	10·000023	1	9·999977	40	25
36	24	8·020021	19831	11·979979	8·020045	19833	11·975955	10·000024	1	9·999976	36	24
37	28	8·031919	19302	11·968081	8·031945	19305	11·968055	10·000025	1	9·999975	32	23
38	32	8·043501	18801	11·956499	8·043527	18803	11·956473	10·000027	3	9·999973	28	22
39	36	8·054781	18325	11·945219	8·054809	18327	11·945191	10·000028	1	9·999972	24	21
40	40	8·065776	17872	11·934224	8·065806	17875	11·934194	10·000029	3	9·999971	20	20
41	44	8·076500	17441	11·923500	8·076531	17444	11·923469	10·000031	1	9·999969	16	19
42	48	8·086965	17031	11·913035	8·086997	17034	11·913003	10·000032	3	9·999968	12	18
43	52	8·097183	16639	11·902817	8·097217	16642	11·902783	10·000034	3	9·999966	8	17
44	56	8·107167	16265	11·892833	8·107202	16268	11·892798	10·000036	1	9·999964	4	16
45	3	8·116926	15908	11·883074	8·116963	15911	11·883037	10·000037	3	9·999963	57	15
46	4	8·126471	15566	11·873529	8·126510	15568	11·873490	10·000039	3	9·999961	56	14
47	8	8·135810	15238	11·864190	8·135851	15241	11·864149	10·000041	1	9·999959	52	13
48	12	8·144953	14924	11·855047	8·144996	14927	11·855004	10·000042	3	9·999958	48	12
49	16	8·153907	14622	11·846093	8·153952	14625	11·846048	10·000044	3	9·999956	44	11
50	20	8·162681	14333	11·837319	8·162727	14336	11·837273	10·000046	3	9·999954	40	10
51	24	8·171280	14054	11·828720	8·171328	14057	11·828672	10·000048	3	9·999952	36	9
52	28	8·179713	13786	11·820287	8·179763	13790	11·820237	10·000050	3	9·999950	32	8
53	32	8·187985	13529	11·812015	8·188036	13532	11·811964	10·000052	3	9·999948	28	7
54	36	8·196102	13280	11·803898	8·196156	13284	11.803844	10·000054	3	9.999946	24	6
55	40	8·204070	13041	11·795930	8·204126	13044	11·795874	10·000056	3	9·999944	20	5
56	44	8·211895	12810	11·788105	8·211953	12814	11·788047	10·000058	3	9·999942	16	4
57	48	8·219581	12587	11·780419	8·219641	12591	11·780359	10·000060	3	9·999940	12	3
58	52	8·227134	12372	11·772866	8·227195	12376	11·772805	10·000062	3	9·999938	8	2
59	56	8·234557	12164	11·765443	8·234621	12168	11·765379	10·000064	3	9·999936	4	1
60	4	8·241855		11·758145	8·341922		11·758078	10·000066		9·999934	0	0
'		Co-sine.		Secant.	Co-tang.		Tangent.	Co-secant.		Sine.	s m	'

89 Degrees. 5 h. 56m.

TABLE 5.

Logarithmic Sines, Tangents, and Secants.

1h. 8m. 17 Degrees.

′	m s	Sine.	Diff.	Co-secant.	Tangent.	Diff.	Co-tang.	Secant.	D.	Co-sine.	s	′
0	0	9·465935	688	10·534065	9·485339	753	10·514661	10·019404	63	9·980596	52	60
1	4	9·466348	688	10·533652	9·485791	752	10·514209	10·019442	65	9·980558	56	59
2	8	9·466761	687	10·533239	9·486242	751	10·513758	10·019481	65	9·980519	52	58
3	12	9·467173	686	10·532827	9·486693	751	10·513307	10·019520	63	9·980480	48	57
4	16	9·467585	685	10·532415	9·487143	750	10·512857	10·019558	65	9·980442	44	56
5	20	9·467996	685	10·532004	9·487593	749	10·512407	10·019597	65	9·980403	40	55
6	24	9·468407	684	10·531593	9·488043	749	10·511957	10·019636	65	9·980364	36	54
7	28	9·468817	683	10·531183	9·488492	748	10·511508	10·019675	65	9·980325	32	53
8	32	9·469227	683	10·530773	9·488941	747	10·511059	10·019714	65	9·980286	28	52
9	36	9·469637	682	10·530363	9·489390	747	10·510610	10·019753	65	9·980247	24	51
10	40	9·470046	681	10·529954	9·489838	746	10·510162	10·019792	65	9·980208	20	50
11	44	9·470455	680	10·529545	9·490286	746	10·509714	10·019831	65	9·980169	16	49
12	48	9·470863	680	10·529137	9·490733	745	10·509267	10·019870	65	9·980130	12	48
13	52	9·471271	679	10·528729	9·491180	744	10·508820	10·019909	65	9·980091	8	47
14	56	9·471679	678	10·528321	9·491627	744	10·508373	10·019948	67	9·980052	4	46
15	9	9·472086	678	10·527914	9·492073	743	10·507927	10·019988	65	9·980012	51	45
16	4	9·472492	677	10·527508	9·492519	743	10·507481	10·020027	65	9·979973	56	44
17	8	9·472898	676	10·527102	9·492965	742	10·507035	10·020066	65	9·979934	52	43
18	12	9·473304	676	10·526696	9·493410	741	10·506590	10·020105	67	9·979895	48	42
19	16	9·473710	675	10·526290	9·493854	740	10·506146	10·020145	65	9·979855	44	41
20	20	9·474115	674	10·525885	9·494299	740	10·505701	10·020184	67	9·979816	40	40
21	24	9·474519	674	10·525481	9·494743	739	10·505257	10·020224	65	9·979776	36	39
22	28	9·474923	673	10·525077	9·495186	739	10·504814	10·020263	67	9·979737	32	38
23	32	9·475327	672	10·524673	9·495630	738	10·504370	10·020303	65	9·979697	28	37
24	36	9·475730	672	10·524270	9·496073	737	10·503927	10·020342	67	9·979658	24	36
25	40	9·476133	671	10·523867	9·496515	737	10·503485	10·020382	65	9·979618	20	35
26	44	9·476536	670	10·523464	9·496957	736	10·503043	10·020421	67	9·979579	16	34
27	48	9·476938	669	10·523062	9·497399	736	10·502601	10·020461	67	9·979539	12	33
28	52	9·477340	669	10·522660	9·497841	735	10·502159	10·020501	67	9·979499	8	32
29	56	9·477741	668	10·522259	9·498282	734	10·501718	10·020541	65	9·979459	4	31
30	10	9·478142	667	10·521858	9·498722	734	10·501278	10·020580	67	9·979420	50	30
31	4	9·478542	667	10·521458	9·499163	733	10·500837	10·020620	67	9·979380	56	29
32	8	9·478942	666	10·521058	9·499603	733	10·500397	10·020660	67	9·979340	52	28
33	12	9·479342	665	10·520658	9·500042	732	10·499958	10·020700	67	9·979300	48	27
34	16	9·479741	665	10·520259	9·500481	731	10·499519	10·020740	67	9·979260	44	26
35	20	9·480140	664	10·519860	9·500920	731	10·499080	10·020780	67	9·979220	40	25
36	24	9·480539	663	10·519461	9·501359	730	10·498641	10·020820	67	9·979180	36	24
37	28	9·480937	663	10·519063	9·501797	730	10·498203	10 020860	67	9·979140	32	23
38	32	9·481334	662	10·518666	9·502235	729	10·497765	10·020900	68	9·979100	28	22
39	36	9·481731	661	10·518269	9·502672	728	10·497328	10·020941	67	9·979059	24	21
40	40	9·482128	661	10·517872	9·503109	728	10·496891	10·020981	67	9·979019	20	20
41	44	9·482525	660	10·517475	9·503546	727	10·496454	10·021021	67	9·978979	16	19
42	48	9·482921	659	10·517079	9·503982	727	10·496018	10·021061	68	9·978939	12	18
43	52	9·483316	659	10·516684	9·504418	726	10·495582	10·021102	67	9·978898	8	17
44	56	9·483712	658	10 516288	9·504854	725	10·495146	10·021142	68	9·978858	4	16
45	11	9·484107	657	10·515893	9·505289	725	10·494711	10·021183	67	9·978817	49	15
46	4	9·484501	657	10·515499	9·505724	724	10·494276	10·021223	67	9·978777	56	14
47	8	9·484895	656	10·515105	9·506159	724	10·493841	10·021263	68	9·978737	52	13
48	12	9·485289	655	10·514711	9·506593	723	10·493407	10·021304	68	9·978696	48	12
49	16	9·485682	655	10·514318	9·507027	722	10·492973	10·021345	67	9·978655	44	11
50	20	9·486075	654	10·513925	9·507460	722	10·492540	10·021385	68	9·978615	40	10
51	24	9·486467	653	10·513533	9·507893	721	10·492107	10.021426	68	9·978574	36	9
52	28	9·486860	653	10·513140	9·508326	721	10·491674	10·021467	67	9·978533	32	8
53	32	9·487251	652	10·512749	9·508759	720	10·491241	10·021507	68	9·978493	28	7
54	36	9·487643	651	10·512357	9·509191	719	10·490809	10·021548	68	9·978452	24	6
55	40	9·488034	651	10·511966	9·509622	719	10·490378	10·021589	68	9·978411	20	5
56	44	9·488424	650	10·511576	9·510054	718	10·489946	10·021630	68	9·978370	16	4
57	48	9·488814	650	10·511186	9·510485	718	10·489515	10·021671	68	9·978329	12	3
58	52	9·489204	649	10·510796	9·510916	717	10·489084	10·021712	68	9·978288	8	2
59	56	9·489593	648	10·510407	9·511346	717	10·488654	10·021753	68	9·978247	4	1
60	12	9 489982		10·510018	9·511776		10·488224	10·021194		9·978206	0	0
′		Co-sine.	′	Secant.	Co.tang.		Tangent.	Co-secant.		Sine.	s m	′

TABLE 5.

Logarithmic Sines, Tangents, and Secants.

1h. 12m. 18 Degrees.

′	m s	Sine.	Diff.	Co-secant.	Tangent.	Diff.	Co-tang.	Secant.	D.	Co-sine.	·	′
0	0	9·489982	648	10·510018	9·511776	716	10·488224	10.021794	68	9·978206	48	60
1	4	9·490371	648	10·509629	9·512206	716	10·487794	10.021835	68	9·978165	56	59
2	8	9·490759	647	10·509241	9·512635	715	10·487365	10.021876	68	9·978124	52	58
3	12	9·491147	646	10·508853	9·513064	714	10·486936	10.021917	69	9·978083	48	57
4	16	9·491535	646	10·508465	9·513493	714	10·486507	10.021958	69	9·978042	44	56
5	20	9·491922	645	10·508078	9·513921	713	10·486079	10·021999	69	9 978001	40	55
6	24	9·492308	644	10·507692	9·514349	713	10·485651	10·022041	69	9·977959	36	54
7	28	9·492695	644	10·507305	9·514777	712	10·485223	10·022082	69	9·977918	32	53
8	32	9·493081	643	10·506919	9·515204	712	10·484796	10·022123	69	9·977877	28	52
9	36	9·493466	642	10·506534	9·515631	711	10·484369	10·022165	69	9·977835	24	51
10	40	9·493851	642	10·506149	9·516057	710	10·483943	10·022206	69	9·977794	20	50
11	44	9·494236	641	10·505764	9·516484	710	10·483516	10·022248	69	9·977752	16	49
12	48	9·494621	641	10·505379	9·516910	709	10·483090	10·022289	69	9·977711	12	48
13	52	9·495005	640	10·504995	9·517335	709	10·482665	10·022331	69	9·977669	8	47
14	56	9·495388	639	10·504612	9·517761	708	10·482239	10·022372	69	9·977628	4	46
15	13	9·495772	639	10 504228	9·518185	708	10·481815	10·022414	69	9·977586	47	45
16	4	9·496154	638	10·503846	9·518610	707	10·481390	10·022456	70	9·977544	56	44
17	8	9·496537	637	10·503463	9·519034	706	10·480966	10·022497	70	9·977503	52	43
18	12	9·496919	637	10·503081	9·519458	706	10·480542	10·022539	70	9·977461	48	42
19	16	9·497301	636	10·502699	9·519882	705	10·480118	10·022581	70	9·977419	44	41
20	20	9·497682	636	10·502318	9·520305	705	10·479695	10·022623	70	9·977377	40	40
21	24	9·498064	635	10·501936	9·520728	704	10·479272	10·022665	70	9·977335	36	39
22	28	9·498444	634	10·501556	9·521151	704	10·478849	10·022707	70	9·977293	32	38
23	32	9·498825	634	10·501175	9·521573	703	10·478427	10·022749	70	9·977251	28	37
24	36	9·499204	633	10·500796	9·521995	703	10·478005	10·022791	70	9·977209	24	36
25	40	9·499584	632	10·500416	9·522417	702	10·477583	10·022833	70	9 977167	20	35
26	44	9·499963	632	10·500037	9 522838	702	10·477162	10·022875	70	9·977125	16	34
27	48	9·500342	631	10·499658	9·523259	701	10·476741	10·022917	70	9·977083	12	33
28	52	9·500721	631	10·499279	9·523680	701	10·476320	10·022959	70	9·977041	8	32
29	56	9·501099	630	10·498901	9·524100	700	10·475900	10·023001	70	9·976999	4	31
30	14	9·501476	629	10·498524	9·524520	699	10·475480	10·023043	70	9·976957	46	30
31	4	9·501854	629	10·498146	9·524939	699	10·475061	10·023086	70	9·976914	56	29
32	8	9·502231	628	10·497769	9·525359	698	10·474641	10·023128	70	9·976872	52	28
33	12	9·502607	628	10·497393	9·525778	698	10·474222	10·023170	71	9·976830	48	27
34	16	9·502984	627	10·497016	9·526197	697	10·473803	10·023213	71	9·976787	44	26
35	20	9·503360	626	10·496640	9·526615	697	10·473385	10·023255	71	9·976745	40	25
36	24	9·503735	626	10·496265	9·527033	696	10·472967	10·023398	71	9·976702	36	24
37	28	9·504110	625	10·495890	9·527451	696	10·472549	10·023340	71	9·976660	32	23
38	32	9·504485	625	10·495515	9·527868	695	10·472132	10·023383	71	9 976617	28	22
39	36	9·504860	624	10·495140	9·528285	695	10·471715	10·023426	71	9·976574	24	21
40	40	9·505234	623	10·494766	9·528702	694	10·471298	10·023468	71	9·976532	20	20
41	44	9·505608	623	10·494392	9·529119	694	10 470881	10·023511	71	9·976489	16	19
42	48	9·505981	622	10·494019	9·529535	693	10·470465	10·023554	71	9·976446	12	18
43	52	9·506354	622	10·493646	9·529950	693	10·470050	10·023596	71	9·976404	8	17
44	56	9·506727	621	10·493273	9·530366	692	10·469634	10·023639	71	9·976361	4	16
45	15	9·507099	620	10·492901	9·530781	691	10·469219	10·023682	71	9·976318	45	15
46	4	9·507471	620	10·492529	9·531196	691	10·468804	10·023725	71	9·976275	56	14
47	8	9·507843	619	10·492157	9·531611	690	10·468389	10·023768	72	9·976232	52	13
48	12	9·508214	619	10·491786	9·532025	690	10·467975	10·023811	72	9·976189	48	12
49	16	9·508585	618	10·491415	9·532439	689	10·467561	10·023854	72	9·976146	44	11
50	20	9·508956	618	10·491044	9·532853	689	10·467147	10·023897	72	9·976103	40	10
51	24	9·509326	617	10·490674	9·533266	688	10·466734	10·023940	72	9·976060	36	9
52	28	9·509696	616	10·490304	9·533679	688	10·466321	10·023983	72	9·976017	32	8
53	32	9·510065	616	10·489935	9·534092	687	10·465908	10·024026	72	9·975974	28	7
54	36	9·510434	615	10·489566	9·534504	687	10·465496	10·024070	72	9·975930	24	6
55	40	9·510803	615	10·489197	9·534916	686	10·465084	10·024113	72	9·975887	30	5
56	44	9·511172	614	10·488828	9·535328	686	10·464672	10·024156	72	9·975844	16	4
57	48	9·511540	613	10·488460	9·535739	685	10·464261	10·024200	72	9·975800	12	3
58	52	9·511907	613	10·488093	9·536150	685	10·463850	10·024243	72	9·975757	8	2
59	56	9·512275	612	10·487725	[illegible]536561	684	10·463439	10·024286	72	9·975714	4	1
60	16	9·512642		10·487358	[illegible]36972		10·463028	10·024330		9·975670	0	0
′		Co-sine.		Secant.	Co-tang.		Tangent.	Co-secant.		Sine.	s m	′

71 Degrees. 4h. 44m.

Logarithmic Sines, Tangents, and Secants.

1h. 16m. 19 Degrees.

′	m s	Sine.	Diff.	Co-secant.	Tangent.	Diff.	Co-tang.	Secant.	D.	Co-sine.		′
0	0	9·512642	612	10·487358	9·536972	684	10·463028	10·024330	72	9·975670	44	60
1	4	9·513009	611	10·486991	9·537382	683	10·462618	10·024373	73	9·975627	56	59
2	8	9·513375	611	10·486625	9·537792	683	10·462208	10.024417	73	9·975583	52	58
3	12	9·513741	610	10·486259	9·538202	682	10·461798	10·024461	73	9·975539	48	57
4	16	9·514107	609	10·485893	9·538611	682	10·461389	10·024504	73	9·975496	44	56
5	20	9·514472	609	10·485528	9·539020	681	10·460980	10·024548	73	9·975452	40	55
6	24	9·514837	608	10·485163	9·539429	681	10·460571	10·024592	73	9·975408	36	54
7	28	9·515202	608	10·484798	9·539837	680	10·460163	10·024635	73	9·975365	32	53
8	32	9·515566	607	10·484434	9·540245	680	10·459755	10·024679	73	9·975321	28	52
9	36	9·515930	607	10·484070	9·540653	679	10·459347	10·024723	73	9·975277	24	51
10	40	9·516294	606	10·483706	9·541061	679	10·458939	10·024767	73	9·975233	20	50
11	44	9·516657	605	10·483343	9·541468	678	10·458532	10·024811	73	9·975189	16	49
12	48	9·517020	605	10·482980	9·541875	678	10·458125	10·024855	73	9·975145	12	48
13	52	9·517382	604	10·482618	9·542281	677	10·457719	10·024899	73	9·975101	8	47
14	56	9·517745	604	10·482255	9·542688	677	10·457312	10·024943	73	9·975057	4	46
15	17	9·518107	603	10·481893	9·543094	676	10·456906	10·024987	73	9·975013	43	45
16	4	9·518468	603	10·481532	9·543499	676	10·456501	10·025031	74	9·974969	56	44
17	8	9·518829	602	10·481171	9·543905	675	10·456095	10·025075	74	9·974925	52	43
18	12	9·519190	601	10·480810	9·544310	675	10·455690	10·025120	74	9·974880	48	42
19	16	9·519551	601	10·480449	9·544715	674	10·455285	10·025164	74	9·974836	44	41
20	20	9·519911	600	10·480089	9·545119	674	10·454881	10·025208	74	9·974792	40	40
21	24	9·520271	600	10·479729	9·545524	673	10·454476	10·025252	74	9·974748	36	39
22	28	9·520634	599	10·479369	9·545928	673	10·454072	10·025297	74	9·974703	32	38
23	32	9·520990	599	10·479010	9·546331	672	10·453669	10·025341	74	9·974659	28	37
24	36	9·521349	598	10·478651	9·546735	672	10·453265	10·025386	74	9·974614	24	36
25	40	9·521707	598	10·478293	9·547138	671	10·452862	10·025430	74	9·974570	20	35
26	44	9·522066	597	10·477934	9·547540	671	10·452460	10·025475	74	9·974525	16	34
27	48	9·522424	596	10·477576	9·547943	670	10·452057	10·025519	74	9·974481	12	33
28	52	9·522781	596	10·477219	9·548345	670	10·451655	10.025564	74	9·974436	8	32
29	56	9·523138	595	10·476862	9·548747	669	10·451253	10·025609	74	9·974391	4	31
30	18	9·523495	595	10·476505	9·549149	669	10·450851	10·025653	75	9·974347	42	30
31	4	9·523852	594	10·476148	9·549550	668	10·450450	10·025698	75	9·974302	56	29
32	8	9·524208	594	10·475792	9·549951	668	10·450049	10·025743	75	9·974257	52	28
33	12	9·524564	593	10·475436	9·550352	667	10·449648	10·025788	75	9·974212	48	27
34	16	9·524920	593	10·475080	9·550752	667	10·449248	10·025833	75	9·974167	44	26
35	20	9·525275	592	10·474725	9·551152	666	10·448848	10·025878	75	9·974122	40	25
36	24	9·525630	591	10·474370	9·551552	666	10·448448	10·025923	75	9·974077	36	24
37	28	9·525984	591	10·474016	9·551952	665	10·448048	10·025968	75	9·974032	32	23
38	32	9·526339	590	10·473661	9·552351	665	10·447649	10·026013	75	9·973987	28	22
39	36	9·526693	590	10·473307	9·552750	665	10·447250	10·026058	75	9·973942	24	21
40	40	9·527046	589	10·472954	9·553149	664	10·446851	10·026103	75	9·973897	20	20
41	44	9·527400	589	10·472600	9·553548	664	10·446452	10·026148	75	9 973852	16	19
42	48	9·527753	588	10·472247	9·553946	663	10·446054	10·026193	75	9·973807	12	18
43	52	9·528105	588	10·471895	9·554344	663	10·445656	10·026239	75	9·973761	8	17
44	56	9·528458	587	10·471542	9·554741	662	10·445259	10·026284	76	9·973716	4	16
45	19	9·528810	587	10·471190	9·555139	662	10·444861	10·026329	76	9·973671	41	15
46	4	9·529161	586	10·470839	9·555536	661	10·444464	10·026375	76	9·973625	56	14
47	8	9·529513	586	10·470487	9·555933	661	10·444067	10·026420	76	9·973580	52	13
48	12	9·529864	585	10·470136	9·556329	660	10·443671	10·026465	76	9·973535	48	12
49	16	9·530215	585	10·469785	9·556725	660	10·443275	10·026511	76	9·973489	44	11
50	20	9·530565	584	10·469435	9·557121	659	10·442879	10·026556	76	9·973444	40	10
51	24	9·530915	584	10·469085	9·557517	659	10·442483	10·026602	76	9·973398	36	9
52	28	9·531265	583	10·468735	9·557913	659	10·442087	10·026648	76	9·973352	32	8
53	32	9·531614	582	10·468386	9·558308	658	10·441692	10·026693	76	9·973307	28	7
54	36	9·531963	582	10·468037	9·558702	658	10·441298	10·026739	76	9·973261	24	6
55	40	9·532312	581	10·467688	9·559097	657	10·440903	10·026785	76	9·973215	20	5
56	44	9·532661	581	10·467339	9·559491	657	10·440509	10·026831	76	9·973169	16	4
57	48	9 533009	580	10·466991	9·559885	656	10·440115	10·026876	76	9·973124	12	3
58	52	9·533357	580	10·466643	9·560279	656	10·439721	10·026922	76	9·973078	8	2
59	56	9·533704	579	10·466296	9·560673	655	10·4[illegible]27	10·026968	76	9·973032	4	1
60	20	9·534052		10·465948	9·561066		10·4[illegible]4	10·027014		9·972986	0	0
′		Co-sine.		Secant.	Co-tang.		Tangent.	Co-secant.		Sine.	s m	′

70 Degrees. 4h. 40m.

TABLE 5.

Logarithmic Sines, Tangents, and Secants.

1h. 20m. 20 Degrees.

′	m s	Sine.	Diff.	Co-secant.	Tangent.	Diff.	Co-tang.	Secant.	D.	Co-sine.		′
0	0	9·534052	578	10·465948	9·561066	655	10·438934	10·027014	77	9·972986	**40**	60
1	4	9·534399	577	10·465601	9·561459	654	10·438541	10·027060	77	9·972940	56	59
2	8	9·534745	577	10·465255	9·561851	654	10·438149	10·027106	77	9·972894	52	58
3	12	9·535092	577	10·464908	9·562244	653	10·437756	10·027152	77	9·972848	48	57
4	16	9·535438	576	10·464562	9·562636	653	10·437364	10·027198	78	9·972802	44	56
5	20	9·535783	576	10. 464217	9·563028	653	10·436972	10·027245	77	9·972755	40	55
6	24	9·536129	575	10·463871	9·563419	652	10·436581	10·027291	77	9·972709	36	54
7	28	9·536474	574	10·463526	9·563811	652	10·436189	10·027337	77	9·972663	32	53
8	32	9·536818	574	10·463182	9·564202	651	10·435798	10·027383	78	9·972617	28	52
9	36	9·537163	573	10·462837	9·564592	651	10·435408	10·027430	77	9·972570	24	51
10	40	9·537507	573	10·462493	9·564983	650	10·435017	10. 027476	77	9·972524	20	50
11	44	9·537851	572	10·462149	9·565373	650	10·434627	10·027522	78	9·972478	16	49
12	48	9·538194	572	10·461806	9·565763	649	10·434237	10·027569	77	9·972431	12	48
13	52	9·538538	571	10·461462	9·566153	649	10·433847	10·027615	78	9·972385	8	47
14	56	9·538880	571	10·461120	9·566542	649	10·433458	10·027662	78	9·972338	4	46
15	**21**	9·539223	570	10·460777	9·566932	648	10·433068	10·027709	77	9·972291	**39**	45
16	4	9·539565	570	10·460435	9·567320	648	10·432680	10·027755	78	9·972245	56	44
17	8	9·539907	569	10·460093	9·567709	647	10·432291	10·027802	78	9·972198	52	43
18	12	9·540249	569	10·459751	9·568098	647	10·431902	10·027849	77	9·972151	48	42
19	16	9·540590	568	10·459410	9·568486	646	10·431514	10·027895	78	9·972105	44	41
20	20	9·540931	568	10·459069	9·568873	646	10·431127	10·027942	78	9·972058	40	40
21	24	9·541272	567	10·458728	9·569261	645	10·430739	10·027989	78	9·972011	36	39
22	28	9·541613	567	10·458387	9·569648	645	10·430352	10·028036	78	9·971964	32	38
23	32	9·541953	566	10·458047	9·570035	645	10·429965	10·028083	78	9·971917	28	37
24	36	9·542293	566	10·457707	9·570422	644	10·429578	10·028130	78	9·971870	24	36
25	40	9·542632	565	10·457368	9·570809	644	10·429191	10·028177	78	9·971823	20	35
26	44	9·542971	565	10·457029	9·571195	643	10·428805	10·028224	78	9·971776	16	34
27	48	9·543310	564	10·456690	9·571581	643	10·428419	10·028271	78	9·971729	12	33
28	52	9·543649	564	10·456351	9·571967	642	10·428033	10·028318	78	9·971682	8	32
29	56	9·543987	563	10·456013	9·572352	642	10·427648	10·028365	78	9·971635	4	31
30	**22**	9·544325	563	10·455675	9·572738	642	10·427262	10·028412	80	9·971588	**38**	30
31	4	9·544663	562	10·455337	9·573123	641	10·426877	10·028460	78	9·971540	56	29
32	8	9·545000	562	10·455000	9·573507	641	10·426493	10·028507	78	9·971493	52	28
33	12	9·545338	561	10·454662	9·573892	640	10·426108	10·028554	80	9·971446	48	27
34	16	9·545674	561	10·454326	9·574276	640	10·425724	10·028602	78	9·971398	44	26
35	20	9·546011	560	10·453989	9·574660	639	10·425340	10·028649	80	9·971351	40	25
36	24	9·546347	560	10·453653	9·575044	639	10·424956	10·028697	78	9·971303	36	24
37	28	9·546683	559	10·453317	9·575427	639	10·424573	10·028744	80	9·971256	32	23
38	32	9·547019	559	10·452981	9 575810	638	10·424190	10·028792	78	9·971208	28	22
39	36	9·547354	558	10·452646	9·576193	638	10·423807	10·028839	80	9·971161	24	21
40	40	9·547689	558	10·452311	9·576576	637	10·423424	10·028887	78	9·971113	20	20
41	44	9·548024	557	10 451976	9·576958	637	10·423042	10·028934	80	9·971066	16	19
42	48	9·548359	557	10·451641	9·577341	636	10·422659	10·028982	80	9·971018	12	18
43	52	9·548693	556	10·451307	9·577723	636	10·422277	10·029030	80	9·970970	8	17
44	56	9·549027	556	10·450973	9·578104	636	10·421896	10·029078	80	9·970922	4	16
45	**23**	9·549360	555	10·450640	9·578486	635	10·421514	10·029126	78	9·970874	**37**	15
46	4	9·549693	555	10·450307	9·578867	635	10·421133	10·029173	80	9·970827	56	14
47	8	9·550026	554	10·449974	9·579248	634	10·420752	10·029221	80	9·970779	52	13
48	12	9·550359	554	10·449641	9·579629	634	10·420371	10·029269	80	9·970731	48	12
49	16	9·550692	553	10·449308	9·580009	634	10·419991	10·029317	80	9·970683	44	11
50	20	9·551024	553	10·448976	9·580389	633	10·419611	10·029365	82	9·970635	40	10
51	24	9·551356	552	10·448644	9·580769	633	10·419231	10·029414	80	9·970586	36	9
52	28	9·551687	552	10·448313	9·581149	632	10·418851	10·029462	80	9·970538	32	8
53	32	9·552018	552	10·447982	9·581528	632	10·418472	10·029510	80	9·970490	28	7
54	36	0·552349	551	10·447651	9·581907	632	10·418093	10·029558	80	9·970442	24	6
55	40	9·552680	551	10·447320	9·582286	631	10·417714	10·029606	82	9·970394	20	5
56	44	9·553010	550	10·446990	9·582665	631	10·417335	10·029655	80	9·970345	16	4
57	48	9·553341	550	10·446659	9·583043	630	10·416957	10·029703	80	9·970297	12	3
58	52	9·553670	549	10·446330	9·583422	630	10·416578	10·029751	82	9·970249	8	2
59	56	9·554000	549	10·446000	9·583800	629	10·416200	10·029800	80	9·970200	4	1
60	**24**	9·554329		10·445671	9·584177		10·415823	10·029848		9·970152	0	0
′		Co-sine.		Secant.	Co-tang.		Tangent.	Co-secant.		Sine.	s m	′

69 Degrees. 4h. 36m.

TABLE 5.

Logarithmic Sines, Tangents, and Secants.

1h. 24m. 21 Degrees.

′	m s	Sine.	Diff.	Co-secant.	Tangent.	Diff.	Co-tang.	Secant.	D.	Co-sine.		′
0	0	9·554329	548	10·445671	9·584177	629	10·415823	10·029848	81	9·970152	**36**	60
1	4	9·554658	548	10·445342	9·584555	629	10·415445	10·029897	81	9·970103	56	59
2	8	9·554987	547	10·445013	9·584932	628	10·415068	10·029945	81	9·970055	52	58
3	12	9·555315	547	10·444685	9·585309	628	10·414691	10·029994	81	9·970006	48	57
4	16	9·555643	546	10·444357	9·585686	627	10·414314	10·030043	81	9·969957	44	56
5	20	9·555971	546	10·444029	9·586062	627	10·413938	10·030091	81	9·969909	40	55
6	24	9·556299	545	10·443701	9·586439	627	10·413561	10·030140	81	9·969860	36	54
7	28	9·556626	545	10·443374	9·586815	626	10·413185	10·030189	81	9·969811	32	53
8	32	9·556953	544	10·443047	9·587190	626	10·412810	10·030238	81	9·969762	28	52
9	36	9·557280	544	10·442720	9·587566	625	10·412434	10·030286	81	9·969714	24	51
10	40	9·557606	543	10·442394	9·587941	625	10·412059	10·030335	81	9·969665	20	50
11	44	9·557932	543	10·442068	9·588316	625	10·411684	10·030384	82	9.969616	16	49
12	48	9·558258	543	10·441742	9·588691	624	10·411309	10·030433	82	9·969567	12	48
13	52	9·558583	542	10·441417	9·589066	624	10·410934	10·030482	82	9·969518	8	47
14	56	9·558909	542	10·441091	9·589440	623	10·410560	10·030531	82	9·969469	4	46
15	**25**	9·559234	541	10·440766	9·589814	623	10·410186	10·030580	82	9·969420	**35**	45
16	4	9·559558	541	10·440442	9·590188	623	10·409812	10·030630	82	9·969370	56	44
17	8	9·559883	540	10·440117	9·590562	622	10·409438	10·030679	82	9·969321	52	43
18	12	9·560207	540	10·439793	9·590935	622	10·409065	10·030728	82	9·969272	48	42
19	16	9·560531	539	10·439469	9·591308	622	10·408692	10·030777	82	9·969223	44	41
20	20	9·560855	539	10·439145	9·591681	621	10·408319	10·030827	82	9·969173	40	40
21	24	9·561178	538	10·438822	9·592054	621	10·407946	10·030876	82	9·969124	36	39
22	28	9·561501	538	10·438499	9·592426	620	10·407574	10·030925	82	9·969075	32	38
23	32	9·561824	537	10·438176	9·592798	620	10·407202	10·030975	82	9·969025	28	37
24	36	9·562146	537	10·437854	9·593171	620	10·406829	10·031024	82	9·968976	24	36
25	40	9·562468	536	10·437532	9·593542	619	10·406458	10·031074	83	9·968926	20	35
26	44	9·562790	536	10·437210	9·593914	619	10·406086	10·031123	83	9·968877	16	34
27	48	9·563112	536	10·436888	9·594285	618	10·405715	10·031173	83	9·968827	12	33
28	52	9·563433	535	10·436567	9·594656	618	10·405344	10·031223	83	9·968777	8	32
29	56	9·563755	535	10·436245	9·595027	618	10·404973	10·031272	83	9·968728	4	31
30	**26**	9·564075	534	10·435925	9·595398	617	10·404602	10·031322	83	9·968678	**34**	30
31	4	9·564396	534	10·435604	9·595768	617	10·404232	10·031372	83	9·968628	56	29
32	8	9·564716	533	10·435284	9·596138	616	10·403862	10·031422	83	9·968578	52	28
33	12	9·565036	533	10·434964	9·596508	616	10·403492	10·031472	83	9·968528	48	27
34	16	9·565356	532	10·434644	9·596878	616	10·403122	10·031521	83	9·968479	44	26
35	20	9·565676	532	10·434324	9·597247	615	10·402753	10·031571	83	9·968429	40	25
36	24	9·565995	531	10·434005	9·597616	615	10·402384	10·031621	83	9·968379	36	24
37	28	9·566314	531	10·433686	9·597985	615	10·402015	10·031671	83	9·968329	32	23
38	32	9·566632	531	10·433368	9·598354	614	10·401646	10·031722	83	9·968278	28	22
39	36	9·566951	530	10·433049	9·598722	614	10·401278	10·031772	84	9 968228	24	21
40	40	9·567269	530	10·432731	9·599091	613	10·400909	10·031822	84	9·968178	20	20
41	44	9·567587	529	10·432413	9·599459	613	10·400541	10·031872	84	9·968128	16	19
42	48	9·567904	529	10·432096	9·599827	613	10·400173	10·031922	84	9·968078	12	18
43	52	9·568222	528	10·431778	9·600194	612	10·399806	10·031973	84	9·968027	8	17
44	56	9·568539	528	10·431461	9·600562	612	10·399438	10·032023	84	9·967977	4	16
45	**27**	9·568856	528	10·431144	9·600929	611	10·399071	10·032073	84	9·967927	**33**	15
46	4	9·569172	527	10·430828	9·601296	611	10·398704	10·032124	84	9·967876	56	14
47	8	9·569488	527	10·430512	9·601662	611	10·398338	10·032174	84	9·967826	52	13
48	12	9·569804	526	10·430196	9·602029	610	10·397971	10·032225	84	9·967775	48	12
49	16	9·570120	526	10·429880	9·602395	610	10·397605	10·032275	84	9·967725	44	11
50	20	9·570435	525	10·429565	9·602761	610	10·397239	10·032326	84	9·967674	40	10
51	24	9·570751	525	10·429249	9·603127	609	10·396873	10·032376	84	9·967624	36	9
52	28	9·571066	524	10·428934	9·603493	609	10·396507	10·032427	84	9·967573	32	8
53	32	9·571380	524	10·428620	9·603858	609	10·396142	10·032478	85	9·967522	28	7
54	36	9·571695	523	10·428305	9·604223	608	10·395777	10·032529	85	9·967471	24	6
55	40	9·572009	523	10·427991	9·604588	608	10·395412	10·032579	85	9·967421	20	5
56	44	9·572323	523	10·427677	9·604953	607	10·395047	10·032630	85	9·967370	16	4
57	48	9·572636	522	10·427364	9·605317	607	10·394683	10·032681	85	9·967319	12	3
58	52	9·572950	522	10·427050	9·605682	607	10·394318	10·032732	85	9·967268	8	2
59	56	9·573263	521	10·426737	9·606046	606	10·393954	10·032783	85	9·967217	4	1
60	**28**	9·573575		10·426425	9·606410		10·393590	10·032834		9·967166	0	0
′		Co-sine.		Secant.	Co-tang.		Tangent.	Co-secant.		Sine.	s m	′

TABLE 5.

Logarithmic Sines, Tangents, and Secants.

1h. 28m. 22 Degrees.

′	m s	Sine.	Diff.	Co-secant.	Tangent.	Diff.	Co-tang.	Secant.	D.	Co-sine.		′
0	[illegible]	9·573575	521	10·426425	9·606410	606	10·393590	10·032834	85	9·967166	32	60
1	4	9·573888	520	10·426112	9·606773	606	10·393227	10·032885	85	9·967115	56	59
2	8	9·574200	520	10·425800	9·607137	605	10·392863	10·032936	85	9·967064	52	58
3	12	9·574512	519	10·425488	9·607500	605	10·392500	10·032987	85	9·967013	48	57
4	16	9·574824	519	10·425176	9·607863	604	10·392137	10·033039	85	9·966961	44	56
5	20	9·575136	519	10·424864	9·608225	604	10·391775	10·033090	85	9·966910	40	55
6	24	9·575447	518	10·424553	9·608588	604	10·391412	10·033141	85	9·966859	36	54
7	28	9·575758	518	10·424242	9·608950	603	10·391050	10·033192	85	9·966808	32	53
8	32	9·576069	517	10·423931	9·609312	603	10·390688	10·033244	86	9·966756	28	52
9	36	9·576379	517	10·423621	9·609674	603	10·390326	10·033295	86	9·966705	24	51
10	40	9·576689	516	10·423311	9·610036	602	10·389964	10·033347	86	9·966653	20	50
11	44	9 576999	516	10·423001	9·610397	602	10·389603	10·033398	86	9·966602	16	49
12	48	9·577309	516	10·422691	9·610759	602	10·389241	10·033450	86	9·966550	12	48
13	52	9·577618	515	10·422382	9·611120	601	10·388880	10·033501	86	9·966499	8	47
14	56	9·577927	515	10·422073	9·611480	601	10·388520	10·033553	86	9·966447	4	46
15	29	9·578236	514	10·421764	9·611841	601	10·388159	10·033605	86	9·966395	31	45
16	4	9·578545	514	10·421455	9·612201	600	10·387799	10·033656	86	9·966344	56	44
17	8	9·578853	513	10·421147	9·612561	600	10·387439	10·033708	86	9·966292	52	43
18	12	9·579162	513	10·420838	9·612921	600	10·387079	10·033760	86	9·966240	48	42
19	16	9·579470	513	10·420530	9·613281	599	10·386719	10·033812	86	9·966188	44	41
20	20	9·579777	512	10·420223	9·613641	599	10·386359	10·033864	86	9·966136	46	40
21	24	9·580085	512	10·419915	9·614000	598	10·386000	10·033915	87	9·966085	36	39
22	28	9·580392	511	10·419608	9·614359	598	10·385641	10·033967	87	9·966033	32	38
23	32	9·580699	511	10·419301	9·614718	598	10·385282	10·034019	87	9·965981	28	37
24	36	9·581005	511	10·418995	9·615077	597	10·384923	10·034071	87	9·965929	24	36
25	40	9·581312	510	10·418688	9·615435	597	10·384565	10·034124	87	9·965876	20	35
26	44	9·581618	510	10·418382	9·615793	597	10·384207	10·034176	87	9·965824	16	34
27	48	9·581924	509	10·418076	9·616151	596	10·383849	10·034228	87	9·965772	12	33
28	52	9·582229	509	10·417771	9·616509	596	10·383491	10·034280	87	9·965720	8	32
29	56	9·582535	509	10·417465	9·616867	596	10·383133	10·034332	87	9·965668	4	31
30	30	9·582840	508	10·417160	9·617224	595	10·382776	10·034385	87	9·965615	30	30
31	4	9·583145	508	10·416855	9·617582	595	10·382418	10·034437	87	9·965563	56	29
32	8	9·583449	507	10·416551	9·617939	595	10·382061	10·034489	87	9·965511	52	28
33	12	9·583754	507	10·416246	9·618295	594	10·381705	10·034542	87	9·965458	48	27
34	16	9·584058	506	10·415942	9·618652	594	10·381348	10·034594	87	9·965406	44	26
35	20	9·584361	506	10·415639	9·619008	594	10·380992	10·034647	88	9·965353	40	25
36	24	9·584665	506	10·415335	9·619364	593	10·380636	10·034699	88	9·965301	36	24
37	28	9·584968	505	10·415032	9·619721	593	10·380279	10·034752	88	9·965248	32	23
38	32	9·585272	505	10·414728	9·620076	593	10·379924	10·034805	88	9·965195	28	22
39	36	9·585574	504	10·414426	9·620432	592	10·379568	10·034857	88	9·965143	24	21
40	40	9·585877	504	10·414123	9·620787	592	10·379213	10·034910	88	9·965090	20	20
41	44	9·586179	503	10·413821	9·621142	592	10·378858	10·034963	88	9·965037	16	19
42	48	9·586482	503	10·413518	9·621497	591	10·378503	10·035016	88	9·964984	12	18
43	52	9·586783	503	10·413217	9·621852	591	10·378148	10·035069	88	9·964931	8	17
44	56	9·587085	502	10·412915	9·622207	590	10·377793	10·035121	88	9·964879	4	16
45	31	9·587386	502	10·412614	9·622561	590	10·377439	10·035174	88	9·964826	29	15
46	4	9·587688	501	10·412312	9·622915	590	10·377085	10·035227	88	9·964773	56	14
47	8	9·587989	501	10·412011	9·623269	589	10·376731	10·035280	88	9·964720	52	13
48	12	9·588289	501	10·411711	9·623623	589	10·376377	10·035334	89	9·964666	48	12
49	16	9·588590	500	10.411410	9·623976	589	10·376024	10·035387	89	9·964613	44	11
50	20	9·588890	500	10·411110	9·624330	588	10·375670	10·035440	89	9·964560	40	10
51	24	9·589190	499	10·410810	9·624683	588	10·375317	10·035493	89	9·964507	36	9
52	28	9·589489	499	10·410511	9·625036	588	10·374964	10·035546	89	9·964454	32	8
53	32	9·589789	499	10·410211	9·625388	587	10·374612	10·035600	89	9·964400	28	7
54	36	9·590088	498	10·409912	9·625741	587	10·374259	10·035653	89	9·964347	24	6
55	40	9·590387	498	10·409613	9·626093	587	10·373907	10·035706	89	9·964294	20	5
56	44	9·590686	497	10·409314	9·626445	586	10·373555	10·035760	89	9·964240	16	4
57	48	9·590984	497	10·409016	9·626797	586	10·373203	10·035813	89	9·964187	12	3
58	52	9·591282	497	10·408718	9·627149	586	10·372851	10·035867	89	9·964133	8	2
59	56	9·591580	496	10·408420	9·627501	585	10·372499	10·035920	89	9·964080	4	1
60	32	9·591878		10·408122	9·627852		10·372148	10·035974		9·964026	0	0
′		Co-sine.		Secant.	Co-tang.		Tangent.	Co-secant.		Sine.	s m	′

67 Degrees. 4h. 28m.

Logarithmic Sines, Tangents, and Secants.

1h. 32m. 23 Degrees.

′	m s	Sine.	Diff.	Co-secant.	Tangent.	Diff.	Co-tang.	Secant.	D.	Co-sine.	s m	′
0	0	9·591878	496	10·408122	9·627852	585	10·372148	10·035974	89	9·964026	[illegible]	60
1	4	9·592176	495	10·407824	9·628203	585	10·371797	10·036028	89	9·9639[illegible]	56	59
2	8	9·592473	495	10·407527	9·628554	585	10·371446	10·036081	89	9·96[illegible]9	52	58
3	12	9·592770	495	10·407230	9·628905	584	10·371095	10·036135	90	9·96[illegible]65	48	57
4	16	9·593067	494	10·406933	9·629255	584	10·370745	10·036189	90	9·963811	44	56
5	20	9·593363	494	10·406637	9·629606	583	10·370394	10·036243	90	9·963757	40	55
6	24	9·593659	493	10·406341	9·629956	583	10·370044	10·036296	90	9·963704	36	54
7	28	9·593955	493	10·406045	9·630306	583	10·369694	10·036350	90	9·963650	32	53
8	32	9·594251	493	10·405749	9·630656	583	10·369344	10·036404	90	9·963596	28	52
9	36	9·594547	492	10·405453	9·631005	582	10·368995	10·036458	90	9·963542	24	51
10	40	9·594842	492	10·405158	9·631355	582	10·368645	10·036512	90	9·963488	20	50
11	44	9·595137	491	10·404863	9·631704	582	10·368296	10·036566	90	9·963434	16	49
12	48	9·595432	491	10·404568	9·632053	581	10·367947	10·036621	90	9·963379	12	48
13	52	9·595727	491	10·404273	9·632401	581	10·367599	10·036675	90	9·963325	8	47
14	56	9·596021	490	10·403979	9·632750	581	10·367250	10·036729	90	9·963271	4	46
15	33	9·596315	490	10·403685	9·633098	580	10·366902	10·036783	90	9·963217	27	45
16	4	9·596609	489	10·403391	9·633447	580	10·366553	10·036837	90	9·963163	56	44
17	8	9·596903	489	10·403097	9·633795	580	10·366205	10·036892	91	9·963108	52	43
18	12	9·597196	489	10·402804	9·634143	579	10·365857	10·036946	91	9·963054	48	42
19	16	9·597490	488	10·402510	9·634490	579	10·365510	10·037001	91	9·962999	44	41
20	20	9·597783	488	10·402217	9·634838	579	10·365162	10·037055	91	9·962945	40	40
21	24	9·598075	487	10·401925	9·635185	578	10·364815	10·037110	91	9·962890	36	39
22	28	9·598368	487	10·401632	9·635532	578	10·364468	10·037164	91	9·962836	32	38
23	32	9·598660	487	10·401340	9·635879	578	10·364121	10·037219	91	9·962781	28	37
24	36	9·598952	486	10·401048	9·636226	577	10·363774	10·037273	91	9·962727	24	36
25	40	9·599244	486	10·400756	9·636572	577	10·363428	10·037328	91	9·962672	20	35
26	44	9·599536	485	10·400464	9·636919	577	10·363081	10·037383	91	9·962617	16	34
27	48	9·599827	485	10·400173	9·637265	577	10·362735	10·037438	91	9·962562	12	33
28	52	9·600118	485	10·399882	9·637611	576	10·362389	10·037492	91	9·962508	8	32
29	56	9·600409	484	10·399591	9·637956	576	10·362044	10·037547	91	9·962453	4	31
30	34	9·600700	484	10·399300	9·638302	576	10·361698	10·037602	92	9·962398	26	30
31	4	9·600990	484	10·399010	9·638647	575	10·361353	10·037657	92	9·962343	56	29
32	8	9·601280	483	10·398720	9·638992	575	10·361008	10·037712	92	9·962288	52	28
33	12	9·601570	483	10·398430	9·639337	575	10·360663	10·037767	92	9·962233	48	27
34	16	9·601860	482	10·398140	9·639682	574	10·360318	10·037822	92	9·962178	44	26
35	20	9·602150	482	10·397850	9·640027	574	10·359973	10·037877	92	9·962123	40	25
36	24	9·602439	482	10·397561	9·640371	574	10·359629	10·037933	92	9·962067	36	24
37	28	9·602728	481	10·397272	9·640716	573	10·359284	10·037988	92	9·962012	32	23
38	32	9·603017	481	10·396983	9·641060	573	10·358940	10·038043	92	9·961957	28	22
39	36	9·603305	481	10·396695	9·641404	573	10·358596	10·038098	92	9·961902	24	21
40	40	9·603594	480	10·396406	9·641747	572	10·358253	10·038154	92	9·961846	20	20
41	44	9·603882	480	10·396118	9·642091	572	10·357909	10·038209	92	9·961791	16	19
42	48	9·604170	479	10·395830	9·642434	572	10·357566	10·038265	92	9·961735	12	18
43	52	9·604457	479	10·395543	9·642777	572	10·357223	10·038320	92	9·961680	8	17
44	56	9·604745	479	10·395255	9·643120	571	10·356880	10·038376	93	9·961624	4	16
45	35	9·605032	478	10·394968	9·643463	571	10·356537	10·038431	93	9·961569	25	15
46	4	9·605319	478	10·394681	9·643806	571	10·356194	10·038487	93	9·961513	56	14
47	8	9·605606	478	10·394394	9·644148	570	10·355852	10·038542	93	9·961458	52	13
48	12	9·605892	477	10·394108	9·644490	570	10·355510	10·038598	93	9·961402	48	12
49	16	9·606179	477	10·393821	9·644832	570	10·355168	10·038654	93	9·961346	44	11
50	20	9·606465	476	10·393535	9·645174	570	10·354826	10·038710	93	9·961290	40	10
51	24	9·606751	476	10·393249	9·645516	569	10·354484	10·038765	93	9·961235	36	9
52	28	9·607036	476	10·392964	9·645857	569	10·354143	10·038821	93	9·961179	32	8
53	32	9·607322	475	10·392678	9·646199	569	10·353801	10·038877	93	9·961123	28	7
54	36	9·607607	475	10·392393	9·646540	568	10·353460	10·038933	93	9·961067	24	6
55	40	9·607892	474	10·392108	9·646881	568	10·353119	10·038989	93	9·961011	20	5
56	44	9·608177	474	10·391823	9·647222	568	10·352778	10·039045	93	9·960955	16	4
57	48	9·608461	474	10·391539	9·647562	567	10·352438	10·039101	93	9·960899	12	3
58	52	9·608745	473	10·391255	9·647903	567	10·352097	10·039157	94	9·960843	8	2
59	56	9·609029	473	10·390971	9·648243	567	10·351757	10·039214	94	9·960786	4	1
60	36	9·609313		10·390687	9·648583		10·351417	10·039270		9·960730	0	0
′	·	Co-sine.		Secant.	Co-tang.		Tangent.	Co-secant.		Sine.	s m	′

66 Degrees. P 4h. 24m.

TABLE 5.

Logarithmic Sines, Tangents, and Secants.

1h. 36m. 24 Degrees.

′	m s	Sine.	Diff.	Co-secant.	Tangent.	Diff.	Co-tang.	Secant.	D.	Co-sine.		′
0	0	9·609313	473	10·390687	9·648583	566	10·351417	10·039270	94	9·960730	**24**	60
1	4	9·609597	472	10·390403	9·648923	566	10·351077	10·039326	94	9·960674	56	59
2	8	9·609880	472	10·390120	9·649263	566	10·350737	10·039382	94	9·960618	52	58
3	12	9·610164	472	10·389836	9·649602	566	10·350398	10·039439	94	9·960561	48	57
4	16	9·610447	471	10·389553	9·649942	565	10·350058	10·039495	94	9·960505	44	56
5	20	9·610729	471	10·389271	9·650281	565	10·349719	10·039552	94	9·960448	40	55
6	24	9·611012	470	10·388988	9·650620	565	10·349380	10·039608	94	9·960392	36	54
7	28	9·611294	470	10·388706	9·650959	564	10·349041	10·039665	94	9·960335	32	53
8	32	9·611576	470	10·388424	9·651297	564	10·348703	10·039721	94	9·960279	28	52
9	36	9·611858	469	10·388142	9·651636	564	10.348364	10·039778	94	9·960222	24	51
10	40	9·612140	469	10·387860	9·651974	563	10·348026	10·039835	94	9·960165	20	50
11	44	9·612421	469	10·387579	9·652312	563	10.347688	10·039891	95	9·960109	16	49
12	48	9·612702	468	10·387298	9·652650	563	10·347350	10·039948	95	9·960052	12	48
13	52	9·612983	468	10·387017	9·652988	563	10·347012	10·040005	95	9·959995	8	47
14	56	9·613264	467	10·386736	9·653326	562·	10·346674	10·040062	95	9·959938	4	46
15	**37**	9·613545	467	10·386455	9·653663	562	10·346337	10·040118	95	9·959882	**23**	45
16	4	9·613825	467	10·386175	9·654000	562	10·346000	10·040175	95	9·959825	56	44
17	8	9·614105	466	10·385895	9·654337	561	10·345663	10·040232	95	9·959768	52	43
18	12	9·614385	466	10·385615	9·654674	561	10·345326	10·040289	95	9·959711	48	42
19	16	9·614665	466	10·385335	9·655011	561	10·344989	10·040346	95	9·959654	44	41
20	20	9·614944	465	10·385056	9·655348	561	10·344652	10·040404	95	9·959596	40	40
21	24	9·615223	465	10·384777	9·655684	560	10·344316	10·040461	95	9·959539	36	39
22	28	9·615502	465	10·384498	9·656020	560	10·343980	10·040518	95	9·959482	32	38
23	32	9·615781	464	10·384219	9·656356	560	10·343644	10·040575	95	9·959425	28	37
24	36	9·616060	464	10·383940	9·656692	559	10·343308	10·040632	95	9·959368	24	36
25	40	9 616338	464	10·383662	9·657028	559	10·342972	10·040690	96	9·959210	20	35
26	44	9·616616	463	10·383384	9·657364	559	10·342636	10·040747	96	9·959253	16	34
27	48	9·616894	463	10·383106	9·657699	559	10·342301	10·040805	96	9·959195	12	33
28	52	9·617172	462	10·382828	9·658034	558	10·341966	10·040862	96	9·959138	8	32
29	56	9·617450	462	10·382550	9·658369	558	10 341631	10·040919	96	9·959080	4	31
30	**38**	9·617727	462	10·382273	9·658704	558	10·341296	10·040977	95	9 959023	**22**	30
31	4	9·618004	461	10·381996	9·659039	558	10·340961	10·041035	96	9·958965	56	29
32	8	9·618281	461	10·381719	9·659373	557	10·340627	10·041092	96	9·958908	52	28
33	12	9·618558	461	10·381442	9·659708	557	10·340292	10·041150	96	9·958850	48	27
34	16	9·618834	460	10·381166	9·660042	557	10·339958	10·041208	96	9·958792	44	26
35	20	9·619110	460	10·380890	9·660376	556	10·339624	10·041266	96	9·958734	40	25
36	24	9·619386	460	10·380614	9·660710	556	10·339290	10·041323	96	9·958677	36	24
37	28	9·619662	459	10·380338	9·661043	556	10·338957	10·041381	96	9·958619	32	23
38	32	9·619938	459	10·380062	9·661377	556	10·338623	10·041439	96	9·958561	28	22
39	36	9·620213	459	10·379787	9·661710	555	10·338290	10·041497	97	9·958503	24	21
40	40	9·620488	458	10·379512	9·662043	555	10·337957	10·041555	97	9·958445	20	20
41	44	9·620763	458	10·379237	9·662376	555	10·337624	10·041613	97	9·958387	16	19
42	48	9·621038	457	10·378962	9·662709	554	10·337291	10·041671	97	9·958329	12	18
43	52	9·621313	457	10·378687	9·663042	554	10·336958	10·041729	97	9·958271	8	17
44	56	9·621587	457	10·378413	9·663375	554	10·336625	10·041787	97	9·958213	4	16
45	**39**	9·621861	456	10·378139	9·663707	554	10 336293	10·041846	97	9·958154	**21**	15
46	4	9·622135	456	10·377865	9·664039	553	10·335961	10·041904	97	9·958096	56	14
47	8	9·622409	456	10·377591	9·664371	553	10·335629	10·041962	97	9·958038	52	13
48	12	9·622682	455	10·377318	9·664703	553	10·335297	10·042021	97	9·957979	48	12
49	16	9·622956	455	10·377044	9·665035	553	10·334965	10·042079	97	9·957921	44	11
50	20	9·623229	455	10·376771	9·665366	552	10·334634	10·042137	97	9·957863	40	10
51	24	9·623502	454	10·376498	9·665697	552	10·334303	10·042196	97	9·957804	36	9
52	28	9·623774	454	10·376226	9·666029	552	10·333971	10·042254	98	9·957746	32	8
53	32	9·624047	454	10·375953	9·666360	551	10·333640	10·042313	98	9·957687	28	7
54	36	9·624319	453	10·375681	9·666691	551	10·333309	10·042372	98	9·957628	24	6
55	40	9·624591	453	10·375409	9·667021	551	10·332979	10·042430	98	9·957570	20	5
56	44	9·624863	453	10·375137	9·667352	551	10·332648	10·042489	98	9 957511	16	4
57	48	9·625135	452	10·374865	9·667682	550	10·332318	10·042548	98	9·957452	12	3
58	52	9·625406	452	10·374594	9·668013	550	10·331987	10·042607	98	9·957393	8	2
59	56	9·625677	452	10·374323	9·668343	550	10·331657	10·042665	98	9·957335	4	1
60	**40**	9·625948		10·374052	9·668672		10·331328	10·042724		9·957276	0	0
′		Co-sine.		Secant.	Co-tang.		Tangent.	Co-secant.		Sine.	s m	′

65 Degrees. 4h. 20m.

TABLE 5.

Logarithmic Sines, Tangents, and Secants.

1h. 40m. 25 Degrees.

′	m s	Sine.	Diff.	Co-secant.	Tangent.	Diff.	Co-tang.	Secant.	D.	Co-sine.		′
0	0	9·625948	451	10·374052	9·668673	550	10·331327	10·042724	98	9·957276	20	60
1	4	9·626219	451	10·373781	9·669002	549	10·330998	10·042783	98	9·957217	56	59
2	8	9·626490	451	10·373510	9·669332	549	10·330668	10·042842	98	9·957158	52	58
3	12	9·626760	450	10·373240	9·669661	549	10·330339	10·042901	98	9·957099	48	57
4	16	9·627030	450	10·372970	9·669991	548	10·330009	10·042960	98	9·957040	44	56
5	20	9·627300	450	10·372700	9·670320	548	10·329680	10·043019	98	9·956981	40	55
6	24	9·627570	449	10·372430	9·670649	548	10·329351	10·043079	99	9·956921	36	54
7	28	9·627840	449	10·372160	9·670977	548	10·329023	10·043138	99	9·956862	32	53
8	32	9·628109	449	10·371891	9·671306	547	10·328694	10·043197	99	9·956803	28	52
9	36	9·628378	448	10·371622	9·671634	547	10·328366	10·043256	99	9·956744	24	51
10	40	9·628647	448	10·371353	9·671963	547	10·328037	10·043316	99	9·956684	20	50
11	44	9·628916	448	10·371084	9·672291	547	10·327709	10·043375	99	9·956625	16	49
12	48	9·629185	447	10·370815	9·672619	546	10·327381	10·043434	99	9·956566	12	48
13	52	9·629453	447	10·370547	9·672947	546	10·327053	10·043494	99	9·956506	8	47
14	56	9·629721	447	10·370279	9·673274	546	10·326726	10·043553	99	9·956447	4	46
15	41	9·629989	446	10·370011	9·673602	546	10·326398	10·043613	99	9·956387	19	45
16	4	9·630257	446	10·369743	9·673929	545	10·326071	10·043673	99	9·956327	56	44
17	8	9·630524	446	10·369476	9·674257	545	10·325743	10·043732	99	9·956268	52	43
18	12	9·630792	445	10·369208	9·674584	545	10·325416	10·043792	100	9·956208	48	42
19	16	9·631059	445	10·368941	9·674910	544	10·325090	10·043852	100	9·956148	44	41
20	20	9·631326	445	10·368674	9·675237	544	10·324763	10·043911	100	9·956089	40	40
21	24	9·631593	444	10·368407	9·675564	544	10·324436	10·043971	100	9·956029	36	39
22	28	9·631859	444	10·368141	9·675890	544	10·324110	10·044031	100	9·955969	32	38
23	32	9·632125	444	10·367875	9·676217	543	10·323783	10·044091	100	9·955909	28	37
24	36	9·632392	443	10·367608	9·676543	543	10·323457	10·044151	100	9·955849	24	36
25	40	9·632658	443	10·367342	9·676869	543	10·323131	10·044211	100	9·955789	20	35
26	44	9·632923	443	10·367077	9·677194	543	10·322806	10·044271	100	9·955729	16	34
27	48	9·633189	442	10·366811	9·677520	542	10·322480	10·044331	100	9·955669	12	33
28	52	9·633454	442	10·366546	9·677846	542	10·322154	10·044391	100	9·955609	8	32
29	56	9·633719	442	10·366281	9·678171	542	10·321829	10·044452	100	9·955548	4	31
30	42	9·633984	441	10·366016	9·678496	542	10·321504	10·044512	100	9·955488	18	30
31	4	9·634249	441	10·365751	9·678821	541	10·321179	10·044572	101	9·955428	56	29
32	8	9·634514	440	10·365486	9·679146	541	10·320854	10·044632	101	9·955368	52	28
33	12	9·634778	440	10·365222	9·679471	541	10·320529	10·044693	101	9·955307	48	27
34	16	9·635042	440	10·364958	9·679795	541	10·320205	10·044753	101	9·955247	44	26
35	20	9·635306	439	10·364694	9 680120	540	10·319880	10·044814	101	9·955186	40	25
36	24	9·635570	439	10·364430	9·680444	540	10·319556	10·044874	101	9·955126	36	24
37	28	9·635834	439	10·364166	9·680768	540	10·319232	10·044935	101	9·955065	32	23
38	32	9·636097	438	10·363903	9·681092	540	10·318908	10·044995	101	9·955005	28	22
39	36	9·636360	438	10·363640	9·681416	539	10·318584	10·045056	101	9·954944	24	21
40	40	9·636623	438	10·363377	9·681740	539	10·318260	10·045117	101	9·954883	20	20
41	44	9·636886	437	10·363114	9·682063	539	10·317937	10·045177	101	9·954823	16	19
42	48	9·637148	437	10·362852	9·682387	539	10·317613	10·045238	101	9·954762	12	18
43	52	9·637411	437	10·362589	9·682710	538	10·317290	10·045299	101	9·954701	8	17
44	56	9·637673	437	10·362327	9·683033	538	10·316967	10·045360	101	9·954640	4	16
45	43	9·637935	436	10·362065	9·683356	538	10·316644	10·045421	101	9·954579	17	15
46	4	9·638197	436	10·361803	9·683679	538	10·316321	10·045482	102	9·954518	56	14
47	8	9·638458	436	10·361542	9·684001	537	10·315999	10·045543	102	9·954457	52	13
48	12	9·638720	435	10·361280	9·684324	537	10·315676	10·045604	102	9·954396	48	12
49	16	9·638981	435	10·361019	9·684646	537	10·315354	10·045665	102	9·954335	44	11
50	20	9·639242	435	10·360758	9·684968	537	10·315032	10·045726	102	9·954274	40	10
51	24	9·639503	434	10·360497	9·685290	536	10·314710	10·045787	102	9·954213	36	9
52	28	9·639764	434	10·360236	9·685612	536	10·314388	10·045848	102	9·954152	32	8
53	32	9·640024	434	10·359976	9·685934	536	10·314066	10·045910	102	9·954090	28	7
54	36	9·640284	433	10·359716	9·686255	536	10·313745	10·045971	102	9·954029	24	6
55	40	9·640544	433	10·359456	9·686577	535	10·313423	10·046032	102	9·953968	20	5
56	44	9·640804	433	10·359196	9·686898	535	10·313102	10·046094	102	9·953906	16	4
57	48	9·641064	432	10·358936	9·687219	535	10·312781	10·046155	102	9·953845	12	3
58	52	9·641324	432	10·358676	9·687540	535	10·312460	10·046217	102	9·953783	8	2
59	56	9·641583	432	10·358417	9·687861	534	10·312139	10·046278	103	9·953722	4	1
60	44	9·641842		10·358158	9·688182		10·311818	10·046340		9·953660	0	0
′		Co-sine.		Secant.	Co-tang.		Tangent.	Co-secant.		Sine.	s m	′

64 Degrees. 4h. 16m.

TABLE 5.

Logarithmic Sines, Tangents, and Secants.

1h. 44m. 26 Degrees.

′	m s	Sine.	Diff.	Co-secant.	Tangent.	Diff.	Co-tang.	Secant.	D.	Co-sine.		′
0	0	9·641842	431	10·358158	9·688182	534	10·311818	10·046340	103	9·953660	16	60
1	4	9·642101	431	10·357899	9·688502	534	10·311498	10·046401	103	9·953599	56	59
2	8	9·642360	431	10·357640	9·688823	534	10·311177	10·046463	103	9·953537	52	58
3	12	9·642618	430	10·257382	9·689143	533	10·310857	10·046525	103	9·953475	48	57
4	16	9·642877	430	10·357123	9·689463	533	10·310537	10·046587	103	9·953413	44	56
5	20	9·643135	430	10·356865	9·689783	533	10·310217	10·046648	103	9·953352	40	55
6	24	9·643393	430	10·356607	9·690103	533	10·309897	10·046710	103	9·953290	36	54
7	28	9·643650	429	10·356350	9·690423	533	10·309577	10·046772	103	9·953228	32	53
8	32	9·643908	429	10·356092	9·690742	532	10·309258	10·046834	103	9·953166	28	52
9	36	9·644165	429	10·355835	9·691062	532	10·308938	10·046896	103	9·953104	24	51
10	40	9·644423	428	10·355577	9·691381	532	10·308619	10·046958	103	9·953042	20	50
11	44	9·644680	428	10·355320	9·691700	532	10·308300	10·047020	104	9·952980	16	49
12	48	9·644936	428	10·355064	9 692019	531	10·307981	10·047082	104	9·952918	12	48
13	52	9·645193	427	10·354807	9·692338	531	10·307662	10·047145	104	9·952855	8	47
14	56	9·645450	427	10·354550	9·692656	531	10·307344	10·047207	104	9·952793	4	46
15	**45**	9·645706	427	10·354294	9·692975	531	10·307025	10 047269	104	9·952731	**15**	45
16	4	9·645962	426	10·354038	9·693293	530	10·306707	10·047331	104	9·952669	56	44
17	8	9·646218	426	10·353782	9·693612	530	10·306388	10·047394	104	9·952606	52	43
18	12	9·646474	426	10·353526	9·693930	530	10·306070	10·047456	104	9·952544	48	42
19	16	9·646729	425	10·353271	9·694248	530	10·305752	10·047519	104	9·952481	44	41
20	20	9·646984	425	10·353016	9·694566	529	10·305434	10·047581	104	9·952419	40	40
21	24	9·647240	425	10·352760	9·694883	529	10·305117	10·047644	104	9·952356	36	39
22	28	9·647494	424	10·352506	9·695201	529	10·304799	10·047706	104	9·952294	32	38
23	32	9·647749	424	10·352251	2·695518	529	10·304482	10·047769	104	9·952231	28	37
24	36	9·648004	424	10·351996	9·695836	529	10·304164	10·047832	104	9·952168	24	36
25	40	9·648258	424	10·351742	9·696153	528	10·303847	10·047894	105	9·952106	20	35
26	44	9·648512	423	10·351488	9·696470	528	10·303530	10·047957	105	9·952043	16	34
27	48	9·648766	423	10·351234	9·696787	528	10·303213	10·048020	105	9·951980	12	33
28	52	9·649020	423	10·350980	9·697103	528	10·302897	10·048083	105	9·951917	8	32
29	56	9·649274	422	10·350726	9·697420	527	10·302580	10·048146	105	9·951854	4	31
30	**46**	9·649527	422	10·350473	9·697736	527	10·302264	10·048209	105	9·951791	**14**	30
31	4	9·649781	422	10·350219	9·698053	527	10·301947	10·048272	105	9·951728	56	29
32	8	9·650034	422	10·349966	9·698369	527	10·301631	10·048335	105	9·951665	52	28
33	12	9·650287	421	10·349713	9·698685	526	10·301315	10·048398	105	9·951602	48	27
34	16	9·650539	421	10·349461	9·699001	526	10·300999	10·048461	105	9·951539	44	26
35	20	9·650792	421	10·349208	9·699316	526	10·300684	10·048524	105	9·951476	40	25
36	24	9·651044	420	10·348956	9·699632	526	10·300368	10·048588	105	9·951412	36	24
37	28	9·651297	420	10·348703	9·699947	526	10·300053	10·048651	106	9·951349	32	23
38	32	9·651549	420	10·348451	9·700263	525	10·299737	10·048714	106	9·951286	28	22
39	36	9·651800	419	10·348200	9·700578	525	10·299422	10·048778	106	9·951222	24	21
40	40	9·652052	419	10·347948	9·700893	525	10·299107	10·048841	106	9·951159	20	20
41	44	9·652304	419	10·347696	9·701208	525	10·298792	10·048904	106	9·951096	16	19
42	48	9·652555	418	10·347445	9·701523	524	10·298477	10·048968	106	9·951032	12	18
43	52	9·652806	418	10·347194	9·701837	524	10·298163	10·049032	106	9·950968	8	17
44	56	9·653057	418	10·346943	9·702152	524	10·297848	10·049095	106	9·950905	4	16
45	**47**	9·653308	418	10·346692	9·702466	524	10·297534	10·049159	106	9·950841	**13**	15
46	4	9·653558	417	10·346442	9·702780	523	10·297220	10·049222	106	9·950778	56	14
47	8	9·653808	417	10·346192	9·703095	523	10·296905	10·049286	106	9·950714	52	13
48	12	9·654059	417	10·345941	9·703409	523	10·296591	10·049350	106	9·950650	48	12
49	16	9·654309	416	10·345691	9·703723	523	10·296277	10·049414	106	9·950586	44	11
50	20	9·654558	416	10·345442	9·704036	523	10·295964	10·049478	107	9·950522	40	10
51	24	9·654808	416	10·345192	9·704350	522	10·295650	10·049542	107	9·950458	36	9
52	28	9·655058	415	10·344942	9·704663	522	10·295337	10·049606	107	9·950394	32	8
53	32	9·655307	415	10·344693	9·704977	522	10·295023	10·049670	107	9·950330	28	7
54	36	9·655556	415	10·344444	9·705290	522	10·294710	10·049734	107	9.950266	24	6
55	40	9·655805	415	10·344195	9·705603	521	10·294397	10·049798	107	9·950202	20	5
56	44	9·656054	414	10·343946	9·705916	521	10·294084	10·049862	107	9·950138	16	4
57	48	9·656302	414	10·343698	9·706228	521	10·293772	10·049926	107	9·950074	12	3
58	52	9·656551	414	10·343449	9 706541	521	10·293459	10·049990	107	9·950010	8	2
59	56	9·656799	413	10·343201	9·706854	521	10·293146	10·050055	107	9·949945	4	1
60	**48**	9·657047		10·342953	9·707166		10·292834	10·050119		9·949881	0	0
′	·	Co-sine.		Secant.	Co-tang.		Tangent.	Co-secant.		Sine.	s m	′

63 Degrees. 4h. 12m.

TABLE 5.

Logarithmic Sines, Tangents, and Secants.

1h. 48m. 27 Degrees.

′	m s	Sine.	Diff.	Co-secant.	Tangent.	Diff.	Co-tang.	Secant.	D.	Co-sine.		′
0	0	9·657047	413	10·342953	9·707166	520	10·292834	10·050119	107	9·949881	12	60
1	4	9·657295	413	10·342705	9·707478	520	10·292522	10·050184	107	9·949816	56	59
2	8	9·657542	412	10·342458	9·707790	520	10·292210	10·050248	107	9·949752	52	58
3	12	9·657790	412	10·342210	9·708102	520	10·291898	10·050312	108	9·949688	48	57
4	16	9·658037	412	10·341963	9·708414	519	10·291586	10·050377	108	9·949623	[illegible]	56
5	20	9·658284	412	10. 341716	9·708726	519	10·291274	10·050442	108	9·949[illegible]	40	55
6	24	9·658531	411	10·341469	9·709037	519	10·290963	10·050506	108	9·[illegible]	36	54
7	28	9·658778	411	10·341222	9·709349	519	10·290651	10·050571	10[illegible]	[illegible]9429	32	53
8	32	9·659025	411	10·340975	9·709660	519	10·290340	10·050636	[illegible]	9·949364	28	52
9	36	9·659271	410	10·340729	9·709971	518	10·290029	10·050700	108	9·949300	24	51
10	40	9·659517	410	10·340483	9·710282	518	10·289718	10. 050765	108	9·949235	20	50
11	44	9·659763	410	10·340237	9·710593	518	10·289407	10·050830	108	9·949170	16	49
12	48	9·660009	409	10·339991	9·710904	518	10·289096	10·050895	108	9·949105	12	48
13	52	9·660255	409	10·339745	9·711215	518	10·288785	10·050960	108	9·949040	8	47
14	56	9·660501	409	10·339499	9·711525	517	10·288475	10·051025	108	9·948975	4	46
15	49	9·660746	409	10·339254	9·711836	517	10·288164	10·051090	108	9·948910	11	45
16	4	9·660991	408	10·339009	9·7121[illegible]	517	10·287854	10·051155	108	9·948845	56	44
17	8	9·661236	408	10·338764	9·71[illegible]	517	10·287544	10·051220	109	9·948780	52	43
18	12	9·661481	408	10·338519	9[illegible]	516	10·287234	10·051285	109	9·948715	48	42
19	16	9·661726	407	10·338274	[illegible]076	516	10·286924	10·051350	109	9·948650	44	41
20	20	9·661970	407	10·338[illegible]	[illegible]713386	516	10·286614	10·051416	109	9·948584	40	40
21	24	9·662214	407	10·337786	9·713696	516	10·286304	10·051481	109	9·948519	36	39
22	28	9·662459	407	10·337541	9·714005	516	10·285995	10·051546	109	9·948454	32	38
23	32	9·662703	406	10·337297	9·714314	515	10·285686	10·051612	109	9·948388	28	37
24	36	9·662946	406	10·337054	9·714624	515	10·285376	10·051677	109	9·948323	24	36
25	40	9·663190	406	10·336810	9·714933	515	10·285067	10·051743	109	9·948257	20	35
26	44	9·663433	405	10·336567	9·715242	515	10·284758	10·051808	109	9·948192	16	34
27	48	9·663677	405	10·336323	9·715551	514	10·284449	10·051874	109	9·948126	12	33
28	52	9·663920	405	10·336080	9·715860	514	10·284140	10·051940	109	9·948060	8	32
29	56	9·664163	405	10·335837	9·716168	514	10·283832	10·052005	110	9·947995	4	31
30	50	9·664406	404	10·335594	9·716477	514	10·283523	10·052071	110	9·947929	10	30
31	4	9·664648	404	10·335352	9·716785	514	10·283215	10·052137	110	9·947863	56	29
32	8	9·664891	404	10·335109	9·717093	513	10·282907	10·052203	110	9·947797	52	28
33	12	9·665133	403	10·334867	9·717401	513	10·282599	10·052269	110	9·947731	48	27
34	16	9·665375	403	10·334625	9·717709	513	10·282291	10·052335	110	9·947665	44	26
35	20	9·665617	403	10·334383	9·718017	513	10·281983	10·052400	110	9·947600	40	25
36	24	9·665859	402	10·334141	9·718325	513	10·281675	10·052467	110	9·947533	36	24
37	28	9·666100	402	10·333900	9·718633	512	10·281367	10·052533	110	9·947467	32	23
38	32	9·666342	402	10·333658	9·718940	512	10·281060	10·052599	110	9·947401	28	22
39	36	9·666583	402	10·333417	9·719248	512	10·280752	10·052665	110	9·947335	24	21
40	40	9·666824	401	10·333176	9·719555	512	10·280445	10·052731	110	9·947269	20	20
41	44	9·667065	401	10 332935	9·719862	512	10·280138	10·052797	110	9·947203	16	19
42	48	9·667305	401	10·332695	9·720169	511	10·279831	10·052864	111	9·947136	12	18
43	52	9·667546	401	10·332454	9·720476	511	10·279524	10·052930	111	9·947070	8	17
44	56	9·667786	400	10·332214	9·720783	511	10·279217	10·052996	111	9·947004	4	16
45	51	9·668027	400	10·331973	9·721089	511	10·278911	10·053063	111	9·946937	9	15
46	4	9·668267	400	10·331733	9·721396	511	10·278604	10·053129	111	9·946871	56	14
47	8	9·668506	399	10·331494	9·721702	510	10·278298	10·053196	111	9·946804	52	13
48	12	9·668746	399	10·331254	9·722009	510	10·277991	10·053262	111	9·946738	48	12
49	16	9·668986	399	10·331014	9·722315	510	10·277685	10·053329	111	9·946671	44	11
50	20	9·669225	399	10·330775	9·722621	510	10·277379	10·053396	111	9·946604	40	10
51	24	9·669464	398	10·330536	9·722927	510	10·277073	10·053462	111	9·946538	36	9
52	28	9·669703	398	10·330297	9·723232	509	10·276768	10·053529	111	9·946471	32	8
53	32	9·669942	398	10·330058	9·723538	509	10·276462	10·053596	111	9·946404	28	7
54	36	9·670181	397	10·329819	9·723844	509	10·276156	10·053663	111	9·946337	24	6
55	40	9·670419	397	10·329581	9·724149	509	10·275851	10·053730	112	9·946270	20	5
56	44	9·670658	397	10·329342	9·724454	509	10·275546	10·053797	112	9·946203	16	4
57	48	9·670896	397	10·329104	9·724759	508	10·275241	10·053864	112	9·946136	12	3
58	52	9·671134	396	10·328866	9·725065	508	10·274935	10·053931	112	9·946069	8	2
59	56	9·671372	396	10·328628	9·725369	508	10·274631	10·053998	112	9·946002	4	1
60	52	9·671609		10·328391	9·725674		10·274326	10·054065		9·945935	8	0
′		Co-sine.		Secant.	Co-tang.		Tangent.	Co-secant.		Sine.	s m	′

62 Degrees. 4h. 8m.

TABLE 5.

Logarithmic Sines, Tangents, and Secants.

1h. 52m. 28 Degrees.

′	m	Sine.	Diff.	Co-secant.	Tangent.	Diff.	Co-tang.	Secant.	D.	Co-sine.		′
	s											
0	0	9·671609	396	10·328391	9·725674	508	10·274326	10·054065	112	9·945935	8	60
1	4	9·671847	395	10·328153	9·725979	508	10·274021	10·054132	112	9·945868	56	59
2	8	9·672084	395	10·327916	9·726284	507	10·273716	10·054200	112	9·945800	52	58
3	12	9·672321	395	10·327679	9·726588	507	10·273412	10·054267	112	9·945733	48	57
4	16	9·672558	395	10·327442	9·726892	507	10·273108	10·054334	112	9·945666	44	56
5	20	9·672795	394	10·327205	9·727197	507	10·272803	10·054402	112	9·945598	40	55
6	24	9·673032	394	10·326968	9·727501	507	10·272499	10·054469	112	9·945531	36	54
7	28	9·673268	394	10·326732	9·727805	506	10·272195	10·054536	113	9·945464	32	53
8	32	9·673505	394	10·326495	9·728109	506	10·271891	10·054604	113	9·945396	28	52
9	36	9·673741	393	10·326259	9·728412	506	10·271588	10·054672	113	9·945328	24	51
10	40	9·673977	393	10·326023	9·728716	506	10·271284	10·054739	113	9·945261	20	50
11	44	9·674213	393	10·325787	9·729020	506	10·270980	10·054807	113	9·945193	16	49
12	48	9·674448	392	10·325552	9·729323	505	10·270677	10·054875	113	9·945125	12	48
13	52	9·674684	392	10·325316	9·729626	505	10·270374	10·054942	113	9·945058	8	47
14	56	9·674919	392	10·325081	9·729929	505	10·270071	10·055010	113	9·944990	4	46
15	53	9·675155	392	10·324845	9·730233	505	10·269767	10·055078	113	9·944922	7	45
16	4	9·675390	391	10·324610	9·730535	505	10·269465	10·055146	113	9·944854	56	44
17	8	9·675624	391	10·324376	9·730838	504	10·269162	10·055214	113	9·944786	52	43
18	12	9·675859	391	10·324141	9·731141	504	10·268859	10·055282	113	9·944718	48	42
19	16	9·676094	391	10·323906	9·731444	504	10·268556	10·055350	113	9·944650	44	41
20	20	9·676328	390	10·323672	9·731746	504	10·268254	10·055418	114	9·944582	40	40
21	24	9·676562	390	10·323438	9·732048	504	10·267952	10·055486	114	9·944514	36	39
22	28	9·676796	390	10·323204	9·732351	503	10·267649	10·055554	114	9·944446	32	38
23	32	9·677030	390	10·322970	9·732653	503	10·267347	10·055623	114	9·944377	28	37
24	36	9·677264	389	10·322736	9·732955	503	10·267045	10·055691	114	9·944309	24	36
25	40	9·677498	389	10·322502	9·733257	503	10·266743	10·055759	114	9·944241	20	35
26	44	9·677731	389	10·322269	9·733558	503	10·266442	10·055828	114	9·944172	16	34
27	48	9·677964	388	10·322036	9·733860	503	10·266140	10·055896	114	9·944104	12	33
28	52	9·678197	388	10·321803	9·734162	502	10·265838	10·055964	114	9·944036	8	32
29	56	9·678430	388	10·321570	9·734463	502	10·265537	10·056033	114	9·943967	4	31
30	54	9·678663	388	10·321337	9·734764	502	10·265236	10·056101	114	9·943899	6	30
31	4	9·678895	387	10·321105	9·735066	502	10·264934	10·056170	114	9·943830	56	29
32	8	9·679128	387	10·320872	9·735367	502	10·264633	10·056239	114	9·943761	52	28
33	12	9·679360	387	10·320640	9·735668	501	10·264332	10·056307	115	9·943693	48	27
34	16	9·679592	387	10·320408	9·735969	501	10·264031	10·056376	115	9·943624	44	26
35	20	9·679824	386	10·320176	9·736269	501	10·263731	10·056445	115	9·943555	40	25
36	24	9·680056	386	10·319944	9·736570	501	10·263430	10·056514	115	9·943486	36	24
37	28	9·680288	386	10·319712	9·736871	501	10·263129	10·056583	115	9·943417	32	23
38	32	9·680519	385	10·319481	9·737171	500	10·262829	10·056652	115	9·943348	28	22
39	36	9·680750	385	10·319250	9·737471	500	10·262529	10·056721	115	9·943279	24	21
40	40	9·680982	385	10·319018	9·737771	500	10·262229	10·056790	115	9·943210	20	20
41	44	9·681213	385	10·318787	9·738071	500	10·261929	10·056859	115	9·943141	16	19
42	48	9·681443	384	10·318557	9·738371	500	10·261629	10·056928	115	9·943072	12	18
43	52	9·681674	384	10·318326	9·738671	500	10·261329	10·056997	115	9·943003	8	17
44	56	9·681905	384	10·318095	9·738971	499	10·261029	10·057066	115	9·942934	4	16
45	55	9·682135	384	10·317865	9.739271	499	10·260729	10·057136	115	9·942864	5	15
46	4	9·682365	383	10·317635	9·739570	499	10·260430	10·057205	116	9·942795	56	14
47	8	9·682595	383	10·317405	9·739870	499	10·260130	10·057274	116	9·942726	52	13
48	12	9·682825	383	10·317175	9·740169	499	10·259831	10·057344	116	9·942656	48	12
49	16	9·683055	383	10·316945	9·740468	498	10·259532	10·057413	116	9·942587	44	11
50	20	9·683284	382	10·316716	9·740767	498	10·259233	10·057483	116	9·942517	40	10
51	24	9·683514	382	10·316486	9·741066	498	10·258934	10·057552	116	9·942448	36	9
52	28	9·683743	382	10·316257	9·741365	498	10·258635	10·057622	116	9·942378	32	8
53	32	9·683972	382	10·316028	9·741664	498	10·258336	10·057692	116	9·942308	28	7
54	36	9·684201	381	10·315799	9·741962	498	10·258038	10·057761	116	9·942239	24	6
55	40	9·684430	381	10·315570	9·742261	497	10·257739	10·057831	116	9·942169	20	5
56	44	9·684658	381	10·315342	9·742559	497	10·257441	10·057901	116	9·942099	16	4
57	48	9·684887	380	10·315113	9·742858	497	10·257142	10·057971	116	9·942029	12	3
58	52	9·685115	380	10·314885	9·743156	497	10·256844	10·058041	116	9·941959	8	2
59	56	9.685343	380	10·314657	9·743454	497	10·256546	10·058111	117	9·941889	4	1
60	56	9·685571		10·314429	9·743752		10·256248	10·058181		9·941819	0	0
′		Co-sine.		Secant.	Co-tang.		Tangent.	Co-secant.		Sine.	s m	′

61 Degrees. 4h. 4m.

TABLE 5.

Logarithmic Sines, Tangents, and Secants.

1h. 56m. 29 Degrees.

′	m s	Sine.	Diff.	Co-secant.	Tangent.	Diff.	Co-tang.	Secant.	D.	Co-sine.		′
0	0	9·685571	380	10·314429	9·743752	496	10·256248	10·058181	117	9·941819	4	60
1	4	9·685799	379	10·314201	9·744050	496	10·255950	10·058251	117	9·941749	56	59
2	8	9·686027	379	10·313973	9·744348	496	10·255652	10·058321	117	9·941679	52	58
3	12	9·686254	379	10·313746	9·744645	496	10·255355	10·058391	117	9·941609	48	57
4	16	9·686482	379	10·313518	9·744943	496	10·255057	10·058461	117	9·941539	44	56
5	20	9·686709	378	10·313291	9·745240	496	10·254760	10·058531	117	9·941469	40	55
6	24	9·686936	378	10·313064	9 745538	495	10·254462	10·058602	117	9·941398	36	54
7	28	9·687163	378	10·312837	9·745835	495	10·254165	10·058672	117	9·941328	32	53
8	32	9·687389	378	10·312611	9·746132	495	10·253868	10·058742	117	9·941258	28	52
9	36	9·687616	377	10·312384	9·746429	495	10·253571	10·058813	117	9·941187	24	51
10	40	9·687843	377	10·312157	9·746726	495	10·253274	10·058883	117	9·941117	20	50
11	44	9·688069	377	10·311931	9·747023	494	10·252977	10·058954	118	9·941046	16	49
12	48	9·688295	377	10·311705	9·747319	494	10·252681	10·059025	118	9·940975	12	48
13	52	9·688521	376	10·311479	9·747616	494	10·252384	10·059095	118	9·940905	8	47
14	56	9·688747	376	10·311253	9·747913	494	10·252087	10·059166	118	9·940834	4	46
15	57	9·688972	376	10·311028	9·748209	494	10·251791	10·059237	118	9·940763	3	45
16	4	9·689198	376	10·310802	9·748505	494	10·251495	10·059307	118	9·940693	56	44
17	8	9·689423	375	10·310577	9·748801	493	10·251199	10·059378	118	9·940622	52	43
18	12	9·689648	375	10·310352	9·749097	493	10·250903	10·059449	118	9·940551	48	42
19	16	9·689873	375	10·310127	9·749393	493	10·250607	10·059520	118	9·940480	44	41
20	20	9·690098	375	10·309902	9·749689	493	10·250311	10·059591	118	9·940409	40	40
21	24	9·690323	374	10·309677	9·749985	493	10·250015	10·059662	118	9·940338	36	39
22	28	9·690548	374	10·309452	9·750281	493	10·249719	10·059733	118	9·940267	32	38
23	32	9·690772	374	10·309228	9·750576	492	10·249424	10·059804	118	9·940196	28	37
24	36	9·690996	374	10·309004	9·750872	492	10·249128	10·059875	119	9·940125	24	36
25	40	9·691220	373	10·308780	9·751167	492	10·248833	10·059946	119	9·940054	20	35
26	44	9·691444	373	10·308556	9·751462	492	10·248538	10·060018	119	9.939982	16	34
27	48	9·691668	373	10·308332	9·751757	492	10·248243	10·060089	119	9.939911	12	33
28	52	9·691892	373	10·308108	9·752052	491	10·247948	10·060160	119	9.939840	8	32
29	56	9·692115	372	10·307885	9·752347	491	10·247653	10·060232	119	9.939768	4	31
30	58	9·692339	372	10·307661	9·752642	491	10·247358	10·060303	119	9.939697	2	30
31	4	9·692562	372	10·307438	9·752937	491	10·247063	10·060375	119	9·939625	56	29
32	8	9·692785	371	10·307215	9·753231	491	10·246769	10·060446	119	9·939554	52	28
33	12	9·693008	371	10·306992	9·753526	491	10·246474	10·060518	119	9·939482	48	27
34	16	9·693231	371	10·306769	9·753820	490	10·246180	10·060590	119	9·939410	44	26
35	20	9·693453	371	10·306547	9·754115	490	10·245885	10·060661	119	9·939339	40	25
36	24	9·693676	370	10·306324	9·754409	490	10·245591	10·060733	120	9·939267	36	24
37	28	9·693898	370	10·306102	9·754703	490	10·245297	10·060805	120	9·939195	32	23
38	32	9·694120	370	10·305880	9·754997	490	10·245003	10·060877	120	9·939123	28	22
39	36	9·694342	370	10·305658	9·755291	490	10·244709	10·060948	120	9·939052	24	21
40	40	9·694564	369	10·305436	9·755585	489	10·244415	10·061020	120	9·938980	20	20
41	44	9·694786	369	10·305214	9·755878	489	10·244122	10·061092	120	9·938908	16	19
42	48	9·695007	369	10·304993	9·756172	489	10·243828	10·061164	120	9·938836	12	18
43	52	9·695229	369	10·304771	9·756465	489	10·243535	10·061237	120	9·938763	8	17
44	56	9·695450	368	10·304550	9·756759	489	10·243241	10·061309	120	9·938691	4	16
45	59	9·695671	368	10·304329	9·757052	489	10·242948	10·061381	120	9·938619	1	15
46	4	9·695892	368	10·304108	9·757345	488	10·242655	10·061453	120	9·938547	56	14
47	8	9·696113	368	10·303887	9·757638	488	10·242362	10·061525	120	9·938475	52	13
48	12	9·696334	367	10·303666	9·757931	488	10·242069	10·061598	121	9·938402	48	12
49	16	9·696554	367	10·303446	9·758224	488	10 241776	10·061670	121	9·938330	44	11
50	20	9·696775	367	10·303225	9·758517	488	10·241483	10·061742	121	9·938258	40	10
51	24	9·696995	367	10·303005	9·758810	488	10·241190	10·061815	121	9·938185	36	9
52	28	9·697215	366	10·302785	9·759102	487	10·240898	10·061887	121	9·938113	32	8
53	32	9·697435	366	10·302565	9·759395	487	10·240605	10·061960	121	9·938040	28	7
54	36	9·697654	366	10·302346	9·759687	487	10·240313	10·062033	121	9·937967	24	6
55	40	9·697874	366	10·302126	9·759979	487	10·240021	10·062105	121	9·937895	20	5
56	44	9·698094	365	10·301906	9·760272	487	10·239728	10·062178	121	9·937822	16	4
57	48	9·698313	365	10·301687	9·760564	487	10·239436	10·062251	121	9·937749	12	3
58	52	9·698532	365	10·301468	9·760856	486	10·239144	10·062324	121	9·937676	8	2
59	56	9·698751	365	10·301249	9·761148	486	10·238852	10·062396	121	9·937604	4	1
60	60	9·698970		10·301010	8·761439		10·238561	10·062469		9·937531	0	0
′		Co-sine.		Secant.	Co-tang.		Tangent.	Co-secant.		Sine.	s m	′

60 Degrees. 4h. 0m.

TABLE 5.

Logarithmic Sines, Tangents, and Secants.

2h. 0m. — 30 Degrees.

′	m s	Sine.	Diff.	Co-secant.	Tangent.	Diff.	Co-tang.	Secant.	D.	Co-sine.		′
0	0	9·698970	364	10·301030	9·761439	486	10·238561	10·062469	121	9·937531	60	60
1	4	9·699189	364	10·300811	9·761731	486	10·238269	10·062542	122	9·937458	56	59
2	8	9·699407	364	10·300593	9·762023	486	10·237977	10·062615	122	9·937385	52	58
3	12	9·699626	364	10·300374	9·762314	486	10·237686	10·062688	122	9·937312	48	57
4	16	9·699844	363	10·300156	9·762606	485	10·237394	10·062762	122	9·937238	44	56
5	20	9·700062	363	10·299938	9·762897	485	10·237103	10·062835	122	9·937165	40	55
6	24	9·700280	363	10·299720	9·763188	485	10·236812	10·062908	122	9·937092	36	54
7	28	9·700498	363	10·299502	9·763479	485	10·236521	10·062981	122	9·937019	32	53
8	32	9·700716	363	10·299284	9·763770	485	10·236230	10·063054	122	9·936946	28	52
9	36	9·700933	362	10·299067	9·764061	485	10·235939	10·063128	122	9·936872	24	51
10	40	9·701151	362	10·298849	9·764352	485	10·235648	10·063201	122	9·936799	20	50
11	44	9·701368	362	10·298632	9·764643	484	10·235357	10·063275	122	9·936725	16	49
12	48	9·701585	362	10·298415	9·764933	484	10·235067	10·063348	123	9·936652	12	48
13	52	9·701802	361	10·298198	9·765224	484	10·234776	10·063422	123	9·936578	8	47
14	56	9·702019	361	10·297981	9·765514	484	10·234486	10·063495	123	9·936505	4	46
15	1	9·702236	361	10·297764	9·765805	484	10·234195	10·063569	123	9·936431	59	45
16	4	9·702452	361	10·297548	9·766095	484	10·233905	10·063643	123	9·936357	56	44
17	8	9·702669	360	10·297331	9·766385	483	10·233615	10·063716	123	9·936284	52	43
18	12	9·702885	360	10·297115	9·766675	483	10·233325	10·063790	123	9·936210	48	42
19	16	9·703101	360	10·296899	9·766965	483	10·233035	10·063864	123	9·936136	44	41
20	20	9·703317	360	10·296683	9·767255	483	10·232745	10·063938	123	9·936062	40	40
21	24	9·703533	359	10·296467	9·767545	483	10·232455	10·064012	123	9·935988	36	39
22	28	9·703749	359	10·296251	9·767834	483	10·232166	10·064086	123	9·935914	32	38
23	32	9·703964	359	10·296036	9·768124	482	10·231876	10·064160	123	9·935840	28	37
24	36	9 704179	359	10·295821	9·768414	482	10·231586	10·064234	124	9·935766	24	36
25	40	9·704395	359	10·295605	9·768703	482	10·231297	10·064308	124	9·935692	20	35
26	44	9·704610	358	10·295390	9·768992	482	10·231008	10·064382	124	9·935618	16	34
27	48	9·704825	358	10·295175	9·769281	482	10·230719	10·064457	124	9·935543	12	33
28	52	9·705040	358	10·294960	9·769570	482	10·230430	10·064531	124	9·935469	8	32
29	56	9·705254	358	10·294746	9·769860	481	10·230140	10·064605	124	9·935395	4	31
30	2	9·705469	357	10·294531	9·770148	481	10·229852	10·064680	124	9·935320	58	30
31	4	9·705683	357	10·294317	9·770437	481	10·229563	10·064754	124	9·935246	56	29
32	8	9·705898	357	10·294102	9·770726	481	10·229274	10·064829	124	9·935171	52	28
33	12	9·706112	357	10·293888	9·771015	481	10·228985	10·064903	124	9·935097	48	27
34	16	9·706326	356	10·293674	9·771303	481	10·228697	10·064978	124	9·935022	44	26
35	20	9·706539	356	10·293461	9·771592	481	10·228408	10·065052	124	9·934948	40	25
36	24	9·706753	356	10·293247	9·771880	480	10·228120	10·065127	124	9·934873	36	24
37	28	9·706967	356	10·293033	9·772168	480	10·227832	10·065202	125	9·934798	32	23
38	32	9·707180	355	10·292820	9·772457	480	10·227543	10·065277	125	9·934723	28	22
39	36	9·707393	355	10·292607	9·772745	480	10·227255	10·065351	125	9·934649	24	21
40	40	9·707606	355	10·292394	9·773033	480	10·226967	10·065426	125	9·934574	20	20
41	44	9·707819	355	10·292181	9·773321	480	10·226679	10·065501	125	9·934499	16	19
42	48	9·708032	354	10·291968	9·773608	480	10·226392	10·065576	125	9·934424	12	18
43	52	9·708245	354	10·291755	9·773896	479	10·226104	10·065651	125	9·934349	8	17
44	56	9·708458	354	10·291542	9·774184	479	10·225816	10·065726	125	9·934274	4	16
45	3	9·708670	354	10·291330	9·774471	479	10·225529	10·065801	125	9·934199	57	15
46	4	9·708882	353	10·291118	9·774759	479	10·225241	10·065877	125	9·934123	56	14
47	8	9·709094	353	10·290906	9·775046	479	10·224954	10·065952	125	9·934048	52	13
48	12	9·709306	353	10·290694	9·775333	479	10·224667	10·066027	125	9·933973	48	12
49	16	9·709518	353	10·290482	9 775621	478	10·224379	10·066102	126	9·933898	44	11
50	20	9·709730	353	10·290270	9·775908	478	10·224092	10·066178	126	9·933822	40	10
51	24	9·709941	352	10 290059	9·776195	478	10·223805	10·066253	126	9·933747	36	9
52	28	9·710153	352	10·289847	9·776482	478	10·223518	10·066329	126	9·933671	32	8
53	32	9·710364	352	10·289636	9·776769	478	10·223231	10·066404	126	9·933596	28	7
54	36	9·710575	352	10·289425	9·777055	478	10·222945	10·066480	126	9·933520	24	6
55	40	9·710786	351	10·289214	9·777342	478	10·222658	10·066555	126	9·933445	20	5
56	44	9·710997	351	10·289003	9·777628	477	10·222372	10·066631	126	9·933369	16	4
57	48	9·711208	351	10·288792	9·777915	477	10·222085	10·066707	126	9·933293	12	3
58	52	9·711419	351	10·288581	9·778201	477	10·221799	10·066783	126	9·933217	8	2
59	56	9·711629	350	10·288371	9·778487	477	10·221513	10·066859	126	9·933141	4	1
60	4	9·711839		10·288161	9·778774		10·221226	10·066934		9·933066	0	0
′		Co-sine.		Secant.	Co-tang.		Tangent.	Co-secant.		Sine.	s m	′

59 Degrees. — 3h. 56m.

TABLE 5.

Logarithmic Sines, Tangents, and Secants.

2h. 4m. 31 Degrees.

′	m s	Sine.	Diff.	Co-secant.	Tangent.	Diff.	Co-tang.	Secant.	D.	Co-sine.		′
0	0	9·711839	350	10·288161	9·778774	477	10·221226	10·066934	126	9·933066	56	60
1	4	9·712050	350	10·287950	9·779060	477	10·220940	10·067010	127	9·932990	56	59
2	8	9·712260	350	10·287740	9·779346	477	10·220654	10·067086	127	9·932914	52	58
3	12	9·712469	349	10·287531	9·779632	476	10·220368	10·067162	127	9·932838	48	57
4	16	9·712679	349	10·287321	9·779918	476	10·220082	10·067238	127	9·932762	44	56
5	20	9·712889	349	10·287111	9·780203	476	10·219797	10·067315	127	9·932685	40	55
6	24	9·713098	349	10·286902	9·780489	476	10·219511	10·067391	127	9·932609	36	54
7	28	9·713308	349	10·286692	9·780775	476	10·219225	10·067467	127	9·932533	32	53
8	32	9·713517	348	10·286483	9·781060	476	10·218940	10·067543	127	9·932457	28	52
9	36	9·713762	348	10·286274	9·781346	476	10·218654	10·067620	127	9·932380	24	51
10	40	9·713935	348	10·286065	9·781631	475	10·218369	10·067696	127	9·932304	20	50
11	44	9·714144	348	10·285856	9·781916	475	10·218084	10·067772	127	9·932228	16	49
12	48	9·714352	347	10·285648	9·782201	475	10·217799	10·067849	127	9·932151	12	48
13	52	9·714561	347	10·285439	9·782486	475	10·217514	10·067925	128	9·932075	8	47
14	56	9·714769	347	10·285231	9·782771	475	10·217229	10·068002	128	9·931998	4	46
15	5	9·714978	347	10·285022	9·783056	475	10·216944	10·068079	128	9·931921	55	45
16	4	9·715186	346	10·284814	9·783341	475	10·216659	10·068155	128	9·931845	56	44
17	8	9·715394	346	10·284606	9·783626	474	10·216374	10·068232	128	9·931768	52	43
18	12	9·715602	346	10·284398	9·783910	474	10·216090	10·068309	128	9·931691	48	42
19	16	9·715809	346	10·284191	9·784195	474	10·215805	10·068386	128	9·931614	44	41
20	20	9·716017	346	10·283983	9·784479	474	10·215521	10·068463	128	9·931537	40	40
21	24	9·716224	345	10·283776	9·784764	474	10·215236	10·068540	128	9·931460	36	39
22	28	9·716432	345	10·283568	9·785048	474	10·214952	10·068617	128	9·931383	32	38
23	32	9·716639	345	10·283361	9·785332	474	10·214668	10·068694	129	9·931306	28	37
24	36	9·716846	345	10·283154	9·785616	473	10·214384	10·068771	129	9·931229	24	36
25	40	9·717053	345	10·282947	9·785900	473	10·214100	10·068848	129	9·931152	20	35
26	44	9·717259	344	10·282741	9·786184	473	10·213816	10·068925	129	9·931075	16	34
27	48	9·717466	344	10·282534	9·786468	473	10·213532	10·069002	129	9·930998	12	33
28	52	9·717673	344	10·282327	9·786752	473	10·213248	10·069079	129	9·930921	8	32
29	56	9·717879	344	10·282121	9·787036	473	10·212964	10·069157	129	9·930843	4	31
30	6	9·718085	343	10·281915	9·787319	473	10·212681	10·069234	129	9·930766	54	30
31	4	9·718291	343	10·281709	9·787603	472	10·212397	10·069312	129	9·930688	56	29
32	8	9·718497	343	10·281503	9·787886	472	10·212114	10·069389	129	9·930611	52	28
33	12	9·718703	343	10·281297	9·788170	472	10·211830	10·069467	129	9·930533	48	27
34	16	9·718909	343	10·281091	9·788453	472	10·211547	10·069544	129	9·930456	44	26
35	20	9·719114	342	10·280886	9·788736	472	10·211264	10·069622	129	9·930378	40	25
36	24	9·719320	342	10·280680	9·789019	472	10·210981	10·069700	130	9·930300	36	24
37	28	9·719525	342	10·280475	9·789302	472	10·210698	10·069777	130	9·930223	32	23
38	32	9·719730	342	10·280270	9·789585	471	10·210415	10·069855	130	9·930145	28	22
39	36	9·719935	341	10·280065	9·789868	471	10·210132	10·069933	130	9·930067	24	21
40	40	9·720140	341	10·279860	9·790151	471	10·209849	10·070011	130	9·929989	20	20
41	44	9·720345	341	10·279655	9·790433	471	10·209567	10·070089	130	9·929911	16	19
42	48	9·720549	341	10·279451	9·790716	471	10·209284	10·070167	130	9·929833	12	18
43	52	9·720754	340	10·279246	9·790999	471	10·209001	10·070245	130	9·929755	8	17
44	56	9·720958	340	10·279042	9·791281	471	10·208719	10·070323	130	9·929677	4	16
45	7	9·721162	340	10·278838	9·791563	470	10·208437	10·070401	130	9·929599	53	15
46	4	9·721366	340	10·278634	9·791846	470	10·208154	10·070479	130	9·929521	56	14
47	8	9·721570	340	10·278430	9·792128	470	10·207872	10·070558	130	9·929442	52	13
48	12	9·721774	339	10·278226	9·792410	470	10·207590	10·070636	131	9·929364	48	12
49	16	9·721978	339	10·278022	9·792692	470	10·207308	10·070714	131	9·929286	44	11
50	20	9·722181	339	10·277819	9·792974	470	10·207026	10·070793	131	9·929270	40	10
51	24	9·722385	339	10·277615	9·793256	470	10·206744	10.070871	131	9·929129	36	9
52	28	9·722588	339	10·277412	9·793538	469	10·206462	10·070950	131	9·929050	32	8
53	32	9·722791	338	10·277209	9·793819	469	10·206181	10·071028	131	9·928972	28	7
54	36	9·722994	338	10·277006	9·794101	469	10·205899	10·071107	131	9·928893	24	6
55	40	9·723197	338	10·276803	9·794383	469	10·205617	10·071185	131	9·928815	20	5
56	44	9·723400	338	10·276600	9·794664	469	10·205336	10·071264	131	9·928736	16	4
57	48	9·723603	337	10·276397	9·794945	469	10·205055	10·071343	131	9·928657	12	3
58	52	9·723805	337	10·276195	9·795227	469	10·204773	10·071422	131	9·928578	8	2
59	56	9·724007	337	10·275993	9·795508	468	10·204492	10·071501	131	9·928499	4	1
60	8	9 724210		10·275790	9·795789		10·204211	10·071580		9·928420	0	0
′		Co-sine.		Secant.	Co.tang.		Tangent.	Co-secant.		Sine.	s m	′

TABLE Ɛ.

Logarithmic Sines, Tangents, and Secants.

2h. 8m. 32 Degrees.

'	m s	Sine.	Diff.	Co-secant.	Tangent.	Diff.	Co-tang.	Secant.	D.	Co-sine.		'
0	0	9·724210	337	10·275790	9·795789	468	10·204211	10·071580	132	9·928420	52	60
1	4	9·724412	337	10·275588	9·796070	468	10·203930	10·071658	132	9·928342	56	59
2	8	9·724614	336	10·275386	9·796351	468	10·203649	10·071737	132	9·928263	52	58
3	12	9·724815	336	10·275184	9·796632	468	10·203368	10·071817	132	9·928183	48	57
4	16	9·725017	336	10·274983	9·796913	468	10·203087	10·071896	132	9·928104	44	56
5	20	9·725219	336	10·274781	9·797194	468	10·202806	10·071975	132	9·928025	40	55
6	24	9·725420	335	10·274580	9·797475	468	10·202525	10·072054	132	9·927946	36	54
7	28	9·725622	335	10·274378	9·797755	467	10·202245	10·072133	132	9·927867	32	53
8	32	9·725823	335	10·274177	9·798036	467	10·201964	10·072213	132	9·927787	28	52
9	36	9·726024	335	10·273976	9·798316	467	10·201684	10·072292	132	9·927708	24	51
10	40	9·726225	335	10·273775	9·798596	467	10·201404	10·072371	132	9·927629	20	50
11	44	9 726426	334	10·273574	9·798877	467	10·201123	10·072451	132	9·927549	16	49
12	48	9·726626	334	10·273374	9·799157	467	10·200843	10·072530	133	9·927470	12	48
13	52	9·726827	334	10·273173	9·799437	467	10·200563	10·072610	133	9·927390	8	47
14	56	9·727027	334	10·272973	9·799717	467	10·200283	10·072690	133	9·927310	4	46
15	9	9·727228	334	10·272772	9·799997	466	10·200003	10·072769	133	9·927231	51	45
16	4	9·727428	333	10·272572	9·800277	466	10·199723	10·072849	133	9·927151	56	44
17	8	9·727628	333	10·272372	9·800557	466	10·199443	10·072929	133	9·927071	52	43
18	12	9·727828	333	10·272172	9·800836	466	10·199164	10·073009	133	9·926991	48	42
19	16	9·728027	333	10·271973	9·801116	466	10·198884	10·073089	133	9·926911	44	41
20	20	9·728227	333	10·271773	9·801396	466	10·198604	10·073169	133	9·926831	40	40
21	24	9·728427	332	10·271573	9·801675	466	10·198325	10·073249	133	9·926751	36	39
22	28	9·728626	332	10·271374	9·801955	466	10·198045	10·073329	133	9·926671	32	38
23	32	9·728825	332	10·271175	9·802234	465	10·197766	10·073409	133	9·926591	28	37
24	36	9·729024	332	10·270976	9·802513	465	10·197487	10·073489	134	9·926511	24	36
25	40	9·729223	331	10·270777	9·802792	465	10·197208	10·073569	134	9·926431	20	35
26	44	9·729422	331	10·270578	9·803072	465	10·196928	10·073649	134	9·926351	16	34
27	48	9·729621	331	10·270379	9·803351	465	10·196649	10·073730	134	9·926270	12	33
28	52	9·729820	331	10·270180	9·803630	465	10·196370	10·073810	134	9·926190	8	32
29	56	9·730018	330	10·269982	9·803908	465	10·196092	10·073890	134	9·926110	4	31
30	10	9·730217	330	10·269783	9·804187	465	10·195813	10·073971	134	9·926029	50	30
31	4	9·730415	330	10·269585	9·804466	464	10·195534	10·074051	134	9·925949	56	29
32	8	9·730613	330	10·269387	9·804745	464	10·195255	10·074132	134	9·925868	52	28
33	12	9·730811	330	10·269189	9·805023	464	10·194977	10·074212	134	9·925788	48	27
34	16	9·731009	329	10·268991	9·805302	464	10·194698	10·074293	134	9·925707	44	26
35	20	9·731206	329	10·268794	9·805580	464	10·194420	10·074374	134	9·925626	40	25
36	24	9·731404	329	10·268596	9·805859	464	10·194141	10·074455	135	9·925545	36	24
37	28	9·731602	329	10·268398	9·806137	464	10·193863	10·074535	135	9·925465	32	23
38	32	9·731799	329	10·268201	9·806415	464	10·193585	10·074616	135	9·925384	28	22
39	36	9·731996	328	10·268004	9·806693	464	10·193307	10·074697	135	9·925303	24	21
40	40	9·732193	328	10·267807	9·806971	463	10·193029	10·074778	135	9·925222	20	20
41	44	9·732390	328	10·267610	9·807249	463	10·192751	10·074859	135	9·925141	16	19
42	48	9·732587	328	10·267413	9·807527	463	10·192473	10·074940	135	9·925060	12	18
43	52	9·732784	328	10·267216	9·807805	463	10·192195	10·075021	135	9·924979	8	17
44	56	9·732980	327	10·267020	9·808083	463	10·191917	10·075103	135	9·924897	4	16
45	11	9·733177	327	10·266823	9·808361	463	10·191639	10·075184	135	9·924816	49	15
46	4	9·733373	327	10·266627	9·808638	463	10·191362	10·075265	136	9·924735	56	14
47	8	9·733569	327	10·266431	9·808916	462	10·191084	10·075346	136	9·924654	52	13
48	12	9·733765	327	10·266235	9·809193	462	10·190807	10·075428	136	9·924572	48	12
49	16	9·733961	326	10. 266039	9·809471	462	10·190529	10·075509	136	9·924491	44	11
50	20	9·734157	326	10·265843	9·809748	462	10·190252	10·075591	136	9·924409	40	10
51	24	9·734353	326	10·265647	9·810025	462	10·189975	10·075672	136	9·924328	36	9
52	28	9·734549	326	10·265451	9·810302	462	10·189698	10·075754	136	9·924246	32	8
53	32	9·734744	325	10·265256	9·810580	462	10·189420	10·075836	136	9·924164	28	7
54	36	9·734939	325	10·265061	9·810857	462	10·189143	10·075917	136	9·924083	24	6
55	40	9·735135	225	10·264865	9·811134	461	10·188866	10·075999	136	9·924001	20	5
56	44	9·735330	325	10·264670	9·811410	461	10·188590	10·076081	136	9·923919	16	4
57	48	9·735525	325	10·264475	9·811687	461	10·188313	10·076163	136	9·923837	12	3
58	52	9·735719	324	10·264281	9·811964	461	10·188036	10·076245	137	9·923755	8	2
59	56	9.·735914	324	10·264086	9·812241	461	10·187759	10·076327	137	9·923673	4	1
60	12	9·736109		10·263891	9·812517		10·187483	10·076409		9·923591	0	0
'		Co-sine.		Secant.	Co-tang.		Tangent.	Co-secant.		Sine.	s m	'

57 Degrees. 3h. 48m.

TABLE 5.

Logarithmic Sines, Tangents, and Secants.

2h. 12m. 33 Degrees.

′	m s	Sine.	Diff.	Co-secant.	Tangent.	Diff.	Co-tang.	Secant.	D..	Co-sine.		
0	0	9·736109	324	10·263891	9·812517	461	10. 187483	10·076409	137	9·923591	48	60
1	4	9·736303	324	10·263697	9·812794	461	10·187206	10·076491	137	9·923509	56	59
2	8	9·736498	324	10·263502	9·813070	461	10·186930	10·076573	137	9·923427	52	58
3	12	9·736692	323	10·263308	9·813347	460	10·186653	10·076655	137	9·923345	48	57
4	16	9·736886	323	10·263114	9·813623	460	10·186377	10·076737	137	9·923263	44	56
5	20	9·737080	323	10·262920	9·813899	460	10·186101	10·076819	137	9·923181	40	55
6	24	9·737274	323	10·262726	9·814175	460	10·185825	10·076902	137	9·923098	36	54
7	28	9·737467	323	10·262533	9·814452	460	10·185548	10·076984	137	9·923016	32	53
8	32	9·737661	322	10·262339	9·814728	460	10·185272	10·077067	137	9·922933	28	52
9	36	9·737855	322	10·262145	9·815004	460	10·184996	10·077149	137	9·922851	24	51
10	40	9·738048	322	10·261952	9·815279	460	10·184721	10·077232	138	9·922768	20	50
11	44	9. 738241	322	10·261759	9·815555	460	10·184445	10·077314	138	9·922686	16	49
12	48	9. 738434	322	10·261566	9·815831	459	10·184169	10·077397	138	9·922603	12	48
13	52	9. 738627	321	10·261373	9·816107	459	10·183893	10·077480	138	9·922520	8	47
14	56	9·738820	321	10·261180	9·816382	459	10·183618	10·077562	138	9·922438	4	46
15	13	9·739013	321	10·260987	9·816658	459	10·183342	10·077645	138	9·922355	47	45
16	4	9·739206	321	10·260794	9·816933	459	10·183067	10·077728	138	9·922272	56	44
17	8	9·739398	321	10·260602	9·817209	459	10·182791	10·077811	138	9·922189	52	43
18	12	9·739590	320	10·260410	9·817484	459	10·182516	10·077894	138	9·922106	48	42
19	16	9·739783	320	10·260217	9·817759	459	10·182241	10·077977	138	9·922023	44	41
20	20	9·739975	320	10·260025	9·818035	459	10·181965	10·078060	138	9·921940	40	40
21	24	9·740167	320	10·259833	9·818310	458	10·181690	10·078143	139	9·921857	36	39
22	28	9·740359	320	10·259641	9·818585	458	10·181415	10·078226	139	9·921774	32	38
23	32	9·740550	319	10·259450	9·818860	458	10·181140	10·078309	139	9·921691	28	37
24	36	9·740742	319	10·259258	9·819135	458	10·180865	10·078393	139	9·921607	24	36
25	40	9·740934	319	10·259066	9·819410	458	10·180590	10·078476	139	9·921524	20	35
26	44	9·741125	319	10·258875	9·819684	458	10·180316	10·078559	139	9·921441	16	34
27	48	9·741316	319	10·258684	9·819959	458	10·180041	10·078643	139	9·921357	12	33
28	52	9·741508	318	10·258492	9·820234	458	10·179766	10·078726	139	9·921274	8	32
29	56	9·741699	318	10·258301	9·820508	458	10·179492	10·078810	139	9·921190	4	31
30	14	9·741889	318	10·258111	9·820783	457	10·179217	10·078893	139	9·921107	46	30
31	4	9·742080	318	10·257920	9·821057	457	10·178943	10·078977	139	9·921023	56	29
32	8	9·742271	318	10·257729	9·821332	457	10·178668	10·079061	139	9·920939	52	28
33	12	9·742462	317	10·257538	9·821606	457	10·178394	10·079144	140	9·920856	48	27
34	16	9·742652	317	10·257348	9·821880	457	10·178120	10·079228	140	9·920772	44	26
35	20	9·742842	317	10·257158	9·822154	457	10·177846	10·079312	140	9·920688	40	25
36	24	9·743033	317	10·256967	9·822429	457	10·177571	10·079396	140	9·920604	36	24
37	28	9·743223	317	10·256777	9·822703	457	10·177297	10·079480	140	9·920520	32	23
38	32	9·743413	316	10·256587	9·822977	457	10·177023	10·079564	140	9·920436	28	22
39	36	9·743602	316	10·256398	9·823250	456	10·176750	10·079648	140	9·920352	24	21
40	40	9·743792	316	10·256208	9·823524	456	10·176476	10·079732	140	9·920268	20	20
41	44	9·743982	316	10·256018	9·823798	456	10·176202	10·079816	140	9·920184	16	19
42	48	9·744171	316	10·255829	9·824072	456	10·175928	10·079901	140	9·920099	12	18
43	52	9·744361	315	10·255639	9·824345	456	10·175655	10·079985	140	9·920015	8	17
44	56	9·744550	315	10·255450	9·824619	456	10·175381	10·080069	141	9·919931	4	16
45	15	9·744739	315	10·255261	9·824893	456	10·175107	10·080154	141	9·919846	45	15
46	4	9·744928	315	10·255072	9·825166	456	10·174834	10·080238	141	9·919762	56	14
47	8	9·745117	315	10·254883	9·825439	456	10·174561	10·080323	141	9·919677	52	13
48	12	9·745306	314	10·254694	9·825713	455	10·174287	10·080407	141	9·919593	48	12
49	16	9·745494	314	10·254506	9·825986	455	10·174014	10·080492	141	9·919508	44	11
50	20	9·745683	314	10·254317	9·826259	455	10·173741	10·080576	141	9·919424	40	10
51	24	9·745871	314	10·254129	9·826532	455	10·173468	10·080661	141	9·919339	36	9
52	28	9·746060	314	10·253940	9·826805	455	10·173195	10·080746	141	9·919254	32	8
53	32	9·746248	313	10·253752	9·827078	455	10·172922	10·080831	141	9·919169	28	7
54	36	9·746436	313	10·253564	9·827351	455	10·172649	10·080915	141	9·919085	24	6
55	40	9·746624	313	10·253376	9·827624	455	10·172376	10·081000	142	9·919000	20	5
56	44	9·746812	313	10·253188	9·827897	455	10·172103	10·081085	142	9·918915	16	4
57	48	9·746999	313	10·253001	9·828170	454	10·171830	10·081170	142	9·918830	12	3
58	52	9·747187	312	10·252813	9·828442	454	10·171558	10·081255	142	9·918745	8	2
59	56	9·747374	312	10·252626	9·828715	454	10·171285	10·081341	142	9·918659	4	1
60	16	9·747562		10·252438	9·828987		10·171013	10·081426		9·918574	0	0
′		Co-sine.		Secant.	Co-tang.		Tangent.	Co-secant.		Sine.	s m	′

56 Degrees. 3h. 44m.

TABLE 5.

Logarithmic Sines, Tangents, and Secants.

2h. 16m. 34 Degrees.

'	m s	Sine.	Dif.	Co-secant.	Tangent.	Dif.	Co-tang.	Secant.	D.	Co-sine.	s m	'
0	0	9·747562	312	10·252438	9·828987	454	10·171013	10.081426	142	9·918574	44	60
1	4	9·747749	312	10·252251	9·829260	454	10·170740	10.081511	142	9·918489	56	59
2	8	9·747936	312	10·252064	9·829532	454	10·170468	10.081596	142	9·918404	52	58
3	12	9·748123	311	10·251877	9·829805	454	10·170195	10.081682	142	9·918318	48	57
4	16	9·748310	311	10·251690	9·830077	454	10·169923	10.081767	142	9·918233	44	56
5	20	9·748497	311	10·251503	9·830349	454	10·169651	10·081853	142	9 918147	40	55
6	24	9·748683	311	10·251317	9·830621	453	10·169379	10·081938	143	9·918062	36	54
7	28	9·748870	311	10·251130	9·830893	453	10·169107	10·082024	143	9·917976	32	53
8	32	9·749056	311	10·250944	9·831165	453	10·168835	10·082109	143	9·917891	28	52
9	36	9·749243	310	10·250757	9·831437	453	10·168563	10·082195	143	9·917805	24	51
10	40	9·749429	310	10·250571	9·831709	453	10·168291	10·082281	143	9·917719	20	50
11	44	9·749615	310	10·250385	9·831981	453	10·168019	10·082366	143	9·917634	16	49
12	48	9·749801	310	10·250199	9·832253	453	10·167747	10·082452	143	9·917548	12	48
13	52	9·749987	310	10·250013	9·832525	453	10·167475	10·082538	143	9·917462	8	47
14	56	9·750172	309	10·249828	9·832796	453	10·167204	10·082624	143	9·917376	4	46
15	17	9·750358	309	10·249642	9·833068	453	10·166932	10·082710	143	9·917290	43	45
16	4	9·750543	309	10·249457	9·833339	452	10·166661	10·082796	143	9·917204	56	44
17	8	9·750729	309	10·249271	9·833611	452	10·166389	10·082882	144	9·917118	52	43
18	12	9·750914	309	10·249086	9·833882	452	10·166118	10·082968	144	9·917032	48	42
19	16	9·751099	308	10·248901	9·834154	452	10·165846	10·083054	144	9·916946	44	41
20	20	9·751284	308	10·248716	9·834425	452	10·165575	10·083141	144	9·916859	40	40
21	24	9·751469	308	10·248531	9·834696	452	10·165304	10·083227	144	9·916773	36	39
22	28	9·751654	308	10·248346	9·834967	452	10·165033	10·083313	144	9·916687	32	38
23	32	9·751839	308	10·248161	9·835238	452	10·164762	10·083400	144	9·916600	28	37
24	36	9·752023	307	10·247977	9·835509	452	10·164491	10·083486	144	9·916514	24	36
25	40	9·752208	307	10·247792	9·835780	452	10·164220	10·083573	144	9 916427	20	35
26	44	9·752392	307	10·247608	9·836051	451	10·163949	10·083659	144	9·916341	16	34
27	48	9·752576	307	10·247424	9·836322	451	10·163678	10·083746	144	9·916254	12	33
28	52	9·752760	307	10·247240	9·836593	451	10·163407	10·083833	145	9·916167	8	32
29	56	9·752944	306	10·247056	9·836864	451	10·163136	10·083919	145	9·916081	4	31
30	18	9·753128	306	10·246872	9·837134	451	10·162866	10·084006	145	9·915994	42	30
31	4	9·753312	305	10·246688	9·837405	451	10·162595	10·084093	145	9·915907	56	29
32	8	9·753495	306	10·246505	9·837675	451	10·162325	10·084180	145	9·915820	52	28
33	12	9·753679	306	10·246321	9·837946	451	10·162054	10·084267	145	9·915733	48	27
34	16	9·753862	305	10·246138	9·838216	451	10·161784	10·084354	145	9·915646	44	26
35	20	9·754046	305	10·245954	9·838487	451	10·161513	10·084441	145	9·915559	40	25
36	24	9·754229	305	10·245771	9·838757	450	10·161243	10·084528	145	9·915472	36	24
37	28	9·754412	305	10·245588	9·839027	450	10·160973	10·084615	145	9·915385	32	23
38	32	9·754595	305	10·245405	9·839297	450	10·160703	10·084703	145	9 915297	28	22
39	36	9·754778	304	10·245222	9·839568	450	10·160432	10·084790	145	9·915210	24	21
40	40	9·754960	304	10·245040	9·839838	450	10·160162	10·084877	146	9·915123	20	20
41	44	9·755143	304	10·244857	9·840108	450	10·159892	10·084965	146	9·915035	16	19
42	48	9·755326	304	10·244674	9·840378	450	10·159622	10·085052	146	9·914948	12	18
43	52	9·755508	304	10·244492	9·840647	450	10·159353	10·085140	146	9·914860	8	17
44	56	9·755690	304	10·244310	9·840917	450	10·159083	10·085227	146	9·914773	4	16
45	19	9·755872	303	10·244128	9·841187	450	10·158813	10·085315	146	9·914685	41	15
46	4	9·756054	303	10·243946	9·841457	449	10·158543	10·085402	146	9·914598	56	14
47	8	9·756236	303	10·243764	9·841726	449	10·158274	10·085490	146	9·914510	52	13
48	12	9·756418	303	10·243582	9·841996	449	10·158004	10·085578	146	9·914422	48	12
49	16	9·756600	303	10·243400	9·842266	449	10·157734	10·085666	146	9·914334	44	11
50	20	9·756782	302	10·243218	9·842535	449	10·157465	10·085754	147	9·914246	40	10
51	24	9·756963	302	10·243037	9·842805	449	10·157195	10·085842	147	9·914158	36	9
52	28	9·757144	302	10·242856	9·843074	449	10·156926	10·085930	147	9·914070	32	8
53	32	9·757326	302	10·242674	9·843343	449	10·156657	10·086018	147	9·913982	28	7
54	36	9·757507	302	10·242493	9·843612	449	10·156388	10·086106	147	9·913894	24	6
55	40	9·757688	301	10·242312	9·843882	449	10·156118	10·086194	147	9·913806	20	5
56	44	9·757869	301	10·242131	9·844151	448	10·155849	10·086282	147	9·913718	16	4
57	48	9·758050	301	10·241950	9·844420	448	10·155580	10·086370	147	9·913630	12	3
58	52	9·758230	301	10·241770	9·844689	448	10·155311	10·086459	147	9·913541	8	2
59	56	9·758411	301	10 41589	9·844958	448	10·155042	10·086547	147	9·913453	4	1
60	20	9·758591		10·241409	9 845227		10·154773	10·086635		9·913365	0	0
'		Co-sine.		Secant.	Co-tang.		Tangent.	Co-secant.	·	Sine.	s m	'

55 Degrees 3h. 40

TABLE 5.

Logarithmic Sines, Tangents, and Secants.

2h. 20m. 35 Degrees.

′	m s	Sine.	Diff.	Co-secant.	Tangent.	Diff.	Co-tang.	Secant.	D.	Co-sine.		′
0	0	9·758591	301	10·241409	9·845227	448	10·154773	10·086635	147	9·913365	**40**	60
1	4	9·758772	300	10·241228	9·845496	448	10·154504	10·086724	147	9·913276	56	59
2	8	9·758952	300	10·241048	9·845764	448	10·154236	10·086813	148	9·913187	52	58
3	12	9·759132	300	10·240868	9·846033	448	10·153967	10·086901	148	9·913099	48	57
4	16	9·759312	300	10·240688	9·846302	448	10·153698	10·086990	148	9·913010	44	56
5	20	9·759492	300	10·240508	9·846570	448	10·153430	10·087078	148	9·912922	40	55
6	24	9·759672	299	10·240328	9 846839	448	10·153161	10·087167	148	9·912833	36	54
7	28	9·759852	299	10·240148	9·847107	447	10·152893	10·087256	148	9·912744	32	53
8	32	9·760031	299	10·239969	9·847376	447	10·152624	10·087345	148	9·912655	28	52
9	36	9·760211	299	10·239789	9·847644	447	10·152356	10·087434	148	9·912566	24	51
10	40	9·760390	299	10·239610	9·847913	447	10·152087	10·087523	148	9·912477	20	50
11	44	9·760569	298	10·239431	9·848181	447	10·151819	10·087612	148	9·912388	16	49
12	48	9·760748	298	10·239252	9·848449	447	10·151551	10·087701	149	9·912299	12	48
13	52	9·760927	298	10·239073	9·848717	447	10·151283	10·087790	149	9·912210	8	47
14	36	9·761106	298	10·238894	9·848986	447	10·151014	10·087879	149	9·912121	4	46
15	**21**	9·761285	298	10·238715	9·849254	447	10·150746	10·087969	149	9·912031	**39**	45
16	4	9·761464	298	10·238536	9·849522	447	10·150478	10·088058	149	9·911942	56	44
17	8	9·761642	297	10·238358	9·849790	446	10·150210	10·088147	149	9·911853	52	43
18	12	9·761821	297	10·238179	9·850058	446	10·149942	10·088237	149	9·911763	48	42
19	16	9·761999	297	10·238001	9·850325	446	10·149675	10·088326	149	9·911674	44	41
20	20	9·762177	297	10·237823	9·850593	446	10·149407	10·088416	149	9·911584	40	40
21	24	9·762356	297	10·237644	9·850861	446	10·149139	10·088505	149	9·911495	36	39
22	28	9·762534	296	10·237466	9·851129	446	10·148871	10·088595	149	9·911405	32	38
23	32	9·762712	296	10·237288	9·851396	446	10·148604	10·088685	150	9·911315	28	37
24	36	9·762889	296	10·237111	9·851664	446	10·148336	10·088774	150	9·911226	24	36
25	40	9·763067	296	10·236933	9·851931	446	10·148069	10·088864	150	9·911136	20	35
26	44	9·763245	296	10·236755	9·852199	446	10·147801	10·088954	150	9.911046	16	34
27	48	9·763422	296	10·236578	9·852466	446	10·147534	10·089044	150	9.910956	12	33
28	52	9·763600	295	10·236400	9·852733	445	10·147267	10·089134	150	9.910866	8	32
29	56	9·763777	295	10·236223	9·853001	445	10·146999	10·089224	150	9.910776	4	31
30	**22**	9·763954	295	10·236046	9·853268	445	10·146732	10·089314	150	9.910686	**38**	30
31	4	9·764131	295	10·235869	9·853535	445	10·146465	10·089404	150	9·910596	56	29
32	8	9·764308	295	10·235692	9·853802	445	10·146198	10·089494	150	9·910506	52	28
33	12	9·764485	294	10·235515	9·854069	445	10·145931	10·089585	150	9·910415	48	27
34	16	9·764662	294	10·235338	9·854336	445	10·145664	10·089675	151	9·910325	44	26
35	20	9·764838	294	10·235162	9·854603	445	10·145397	10·089765	151	9·910235	40	25
36	24	9·765015	294	10·234985	9·854870	445	10·145130	10·089856	151	9·910144	36	24
37	28	9·765191	294	10·234809	9·855137	445	10·144863	10·089946	151	9·910054	32	23
38	32	9·765367	294	10·234633	9·855404	445	10·144596	10·090037	151	9·909963	28	22
39	36	9·765544	293	10·234456	9·855671	444	10·144329	10·090127	151	9·909873	24	21
40	40	9·765720	293	10·234280	9·855938	444	10·144062	10·090218	151	9·909782	20	20
41	44	9·765896	293	10·234104	9·856204	444	10·143796	10·090309	151	9·909691	16	19
42	48	9·766072	293	10·233928	9·856471	444	10·143529	10·090399	151	9·909601	12	18
43	52	9·766247	293	10·233753	9·856737	444	10·143263	10·090490	151	9·909510	8	17
44	56	9·766423	293	10·233577	9·857004	444	10·142996	10·090581	151	9·909419	4	16
45	**23**	9·766598	292	10·233402	9·857270	444	10·142730	10·090672	152	9·909328	**37**	15
46	4	9·766774	292	10·233226	9·857537	444	10·142463	10·090763	152	9·909237	56	14
47	8	9·766949	292	10·233051	9·857803	444	10·142197	10·090854	152	9·909146	52	13
48	12	9·767124	292	10·232876	9·858069	444	10·141931	10·090945	152	9·909055	48	12
49	16	9·767300	292	10·232700	9·858336	444	10 141664	10·091036	152	9·908964	44	11
50	20	9·767475	291	10·232525	9·858602	444	10·141398	10·091127	152	9·908873	40	10
51	24	9·767649	291	10·232351	9·858868	443	10·141132	10·091219	152	9·908781	36	9
52	28	9·767824	291	10·232176	9·859134	443	10·140866	10·091310	152	9·908690	32	8
53	32	9·767999	291	10·232001	9·859400	443	10·140600	10·091401	152	9·908599	28	7
54	36	9·768173	291	10·231827	9·859666	443	10·140334	10·091493	152	9·908507	24	6
55	40	9·768348	290	10·231652	9·859932	443	10·140068	10·091584	153	9·908416	20	5
56	44	9·768522	290	10·231478	9·860198	443	10·139802	10·091676	153	9·908324	16	4
57	48	9·768697	290	10·231303	9·860464	443	10·139536	10·091767	153	9·908233	12	3
58	52	9·768871	290	10·231129	9·860730	443	10·139270	10·091859	153	9·908141	8	2
59	56	9·769045	290	10·230955	9·860995	443	10·139005	10·091951	153	9·908049	4	1
60	**24**	9·769219		10·230781	9·861261		10·138739	10·092042		9·907958	0	0
′		Co-sine.		Secant.	Co-tang.		Tangent.	Co-secant.		Sine.	s m	′

TABLE 5.

Logarithmic Sines, Tangents, and Secants.

2h. 24m. 36 Degrees.

′	m s	Sine.	Diff.	Co-secant.	Tangent.	Diff.	Co-tang.	Secant.	D.	Co-sine.		′
0	0	9·769219	290	10·230781	9·861261	443	10·138739	10·092042	153	9·907958	36	60
1	4	9·769393	289	10·230607	9·861527	443	10·138473	10·092134	153	9·907866	56	59
2	8	9·769566	289	10·230434	9·861792	443	10·138208	10·092226	153	9·907774	52	58
3	12	9·769740	289	10·230260	9·862058	442	10·137942	10·092318	153	9·907682	48	57
4	16	9·769913	289	10·230087	9·862323	442	10·137677	10·092410	153	9·907590	44	56
5	20	9·770087	289	10·229913	9·862589	442	10·137411	10·092502	153	9·907498	40	55
6	24	9·770260	288	10·229740	9·862854	442	10·137146	10·092594	153	9·907406	36	54
7	28	9·770433	288	10·229567	9·863119	442	10·136881	10·092686	154	9·907314	32	53
8	32	9·770606	288	10·229394	9·863385	442	10·136615	10·092778	154	9·907222	28	52
9	36	9·770779	288	10·229221	9·863650	442	10·136350	10·092871	154	9·907129	24	51
10	40	9·770952	288	10·229048	9·863915	442	10·136084	10·092963	154	9·907037	20	50
11	44	9·771125	288	10·228875	9·864180	442	10·135820	10·093055	154	9.906945	16	49
12	48	9·771298	287	10·228702	9·864445	442	10·135555	10·093148	154	9·906852	12	48
13	52	9·771470	287	10·228530	9·864710	442	10·135290	10·093240	154	9·906760	8	47
14	56	9·771643	287	10·228357	9·864975	442	10·135025	10·093333	154	9·906667	4	46
15	25	9·771815	287	10·228185	9·865240	441	10·134760	10·093425	154	9·906575	35	45
16	4	9·771987	287	10·228013	9·865505	441	10·134495	10·093518	154	9·906482	56	44
17	8	9·772159	287	10·227841	9·865770	441	10·134230	10·093611	155	9·906389	52	43
18	12	9·772331	286	10·227669	9·866035	441	10·133965	10·093704	155	9·906296	48	42
19	16	9·772503	286	10·227497	9·866300	441	10·133700	10·093796	155	9·906204	44	41
20	20	9·772675	286	10·227325	9·866564	441	10·133436	10·093889	155	9·906111	40	40
21	24	9·772847	286	10·227153	9·866829	441	10·133171	10·093982	155	9·906018	36	39
22	28	9·773018	286	10·226982	9·867094	441	10·132906	10·094075	155	9·905925	32	38
23	32	9·773190	286	10·226810	9·867358	441	10·132642	10·094168	155	9·905832	28	37
24	36	9·773361	285	10·226639	9·867623	441	10·132377	10·094261	155	9·905739	24	36
25	40	9·773533	285	10·226467	9·867887	441	10·132113	10·094355	155	9·905645	20	35
26	44	9·773704	285	10·226296	9·868152	441	10·131848	10·094448	155	9·905552	16	34
27	48	9·773875	285	10·226125	9·868416	441	10·131584	10·094541	155	9·905459	12	33
28	52	9·774046	285	10·225954	9·868680	440	10·131320	10·094634	156	9·905366	8	32
29	56	9·774217	285	10·225783	9·868945	440	10·131055	10·094728	156	9·905272	4	31
30	26	9·774388	284	10·225612	9·869209	440	10·130791	10·094821	156	9·905179	34	30
31	4	9·774558	284	10·225442	9·869473	440	10·130527	10·094915	156	9·905085	56	29
32	8	9·774729	284	10·225271	9·869737	440	10·130263	10·095008	156	9·904992	52	28
33	12	9·774899	284	10·225101	9·870001	440	10·129999	10·095102	156	9·904898	48	27
34	16	9·775070	284	10·224930	9·870265	440	10·129735	10·095196	156	9·904804	44	26
35	20	9·775240	284	10·224760	9·870529	440	10·129471	10·095289	156	9·904711	40	25
36	24	9·775410	283	10·224590	9·870793	440	10·129207	10·095383	156	9·904617	36	24
37	28	9·775580	283	10·224420	9·871057	440	10·128943	10·095477	156	9·904523	32	23
38	32	9·775750	283	10·224250	9 871321	440	10·128679	10·095571	157	9·904429	28	22
39	36	9·775920	283	10·224080	9·871585	440	10·128415	10·095665	157	9 904335	24	21
40	40	9·776090	283	10·223910	9·871849	440	10·128151	10·095759	157	9·904241	20	20
41	44	9·776259	283	10·223741	9·872112	439	10·127888	10·095853	157	9·904147	16	19
42	48	9·776429	282	10·223571	9·872376	439	10·127624	10·095947	157	9·904053	12	18
43	52	9·776598	282	10·223402	9·872640	439	10·127360	10·096041	157	9·903959	8	17
44	56	9·776768	282	10·223232	9·872903	439	10·127097	10·096136	157	9·903864	4	16
45	27	9·776937	282	10·223063	9·873167	439	10·126833	10·096230	157	9·903770	33	15
46	4	9·777106	282	10·222894	9·873430	439	10·126570	10·096324	157	9·903676	56	14
47	8	9·777275	281	10·222725	9·873694	439	10·126306	10·096419	157	9·903581	52	13
48	12	9·777444	281	10·222556	9·873957	439	10·126043	10·096513	157	9·903487	48	12
49	16	9·777613	281	10·222387	9·874220	439	10·125780	10·096608	158	9·903392	44	11
50	20	9·777781	281	10·222219	9·874484	439	10·125516	10·096702	158	9·903298	40	10
51	24	9·777950	281	10·222050	9·874747	439	10·125253	10·096797	158	9·903203	36	9
52	28	9·778119	281	10·221881	9·875010	439	10·124990	10·096892	158	9·903108	32	8
53	32	9·778287	280	10·221713	9·875273	439	10·124727	10·096986	158	9·903014	28	7
54	36	9·778455	280	10·221545	9·875536	439	10·124464	10·097081	158	9·902919	24	6
55	40	9·778624	280	10·221376	9·875800	438	10·124200	10·097176	158	9·902824	20	5
56	44	9·778792	280	10·221208	9·876063	438	10·123937	10·097271	158	9·902729	16	4
57	48	9·778960	280	10·221040	9·876326	438	10·123674	10·097366	158	9·902634	12	3
58	52	9·779128	280	10·220872	9·876589	438	10·123411	10·097461	159	9·902539	8	2
59	56	9·779295	279	10·220705	9·876851	438	10·123149	10·097556	159	9·902444	4	1
60	28	9·779463		10·220537	9·877114		10·122886	10·097651		9·902349	0	0
′		Co-sine.		Secant.	Co-tang.		Tangent.	Co-secant.		Sine.	s m	′

53 Degrees. 3h. 32m.

TABLE 5.

Logarithmic Sines, Tangents, and Secants.

2h. 28m. 37 Degrees.

′	m s	Sine.	Diff.	Co-secant.	Tangent.	Diff.	Co-tang.	Secant.	D.	Co-sine.		′
0	0	9·779463	279	10·220537	9·877114	438	10·122886	10·097651	159	9·902349	32	60
1	4	9·779631	279	10·220369	9·877377	438	10·122623	10·097747	159	9·902253	56	59
2	8	9·779798	279	10·220202	9·877640	438	10·122360	10. 097842	159	9·902158	52	58
3	12	9·779966	279	10·220034	9·877903	438	10·122097	10·097937	159	9·902063	48	57
4	16	9·780133	279	10·219867	9·878165	438	10·121835	10·098033	159	9·901967	44	56
5	20	9·780300	278	10·219700	9·878428	438	10·121572	10·098128	159	9·901872	40	55
6	24	9·780467	278	10·219533	9·878691	438	10·121309	10·098224	159	9·901776	36	54
7	28	9·780634	278	10·219366	9·878953	437	10·121047	10·098319	159	9·901681	32	53
8	32	9·780801	278	10·219199	9·879216	437	10·120784	10·098415	159	9·901585	28	52
9	36	9·780968	278	10·219032	9·879478	437	10·120522	10·098510	159	9·901490	24	51
10	40	9·781134	278	10·218866	9·879741	437	10·120259	10·098606	160	9·901394	20	50
11	44	9·781301	277	10·218699	9·880003	437	10·119997	10·098702	160	9·901298	16	49
12	48	9·781468	277	10·218532	9·880265	437	10·119735	10·098798	160	9·901202	12	48
13	52	9·781634	277	10·218366	9·880528	437	10·119472	10·098894	160	9·901106	8	47
14	56	9·781800	277	10·218200	9·880790	437	10·119210	10·098990	160	9·901010	4	46
15	29	9·781966	277	10·218034	9·881052	437	10·118948	10·099086	160	9·900914	31	45
16	4	9·782132	277	10·217868	9·881314	437	10·118686	10·099182	160	9·900818	56	44
17	8	9·782298	276	10·217702	9·881576	437	10·118424	10·099278	160	9·900722	52	43
18	12	9·782464	276	10·217536	9·881839	437	10·118161	10·099374	160	9·900626	48	42
19	16	9·782630	276	10·217370	9·882101	437	10·117899	10 099471	160	9·900529	44	41
20	20	9·782796	276	10·217204	9·882363	437	10·117637	10·099567	161	9·900433	40	40
21	24	9·782961	276	10·217039	9·882625	436	10·117375	10·099663	161	9·900337	36	39
22	28	9·783127	276	10·216873	9·882887	436	10·117113	10·099760	161	9·900240	32	38
23	32	9·783292	275	10·216708	9·883148	436	10·116852	10·099856	161	9·900144	28	37
24	36	9·783458	275	10·216542	9·883410	436	10·116590	10·099953	161	9·900047	24	36
25	40	9·783623	275	10·216377	9·883672	436	10·116328	10·100049	161	9·899951	20	35
26	44	9·783788	275	10·216212	9·883934	436	10·116066	10·100146	161	9·899854	16	34
27	48	9·783953	275	10·216047	9·884196	436	10·115804	10·100243	161	9·899757	12	33
28	52	9·784118	275	10·215882	9·884457	436	10·115543	10. 100340	161	9·899660	8	32
29	56	9·784282	274	10·215718	9·884719	436	10·115281	10·100436	161	9·899564	4	31
30	30	9·784447	274	10·215553	9·884980	436	10·115020	10·100533	162	9·899467	30	30
31	4	9·784612	274	10·215388	9·885242	436	10·114758	10·100630	162	9·899370	56	29
32	8	9·784776	274	10·215224	9·885503	436	10·114497	10·100727	162	9·899273	52	28
33	12	9·784941	274	10·215059	9·885765	436	10·114235	10·100824	162	9·899176	48	27
34	16	9·785105	274	10·214895	9·886026	436	10·113974	10·100922	162	9·899078	44	26
35	20	9·785269	273	10·214731	9·886288	436	10·113712	10·101019	162	9·898981	40	25
36	24	9·785433	273	10·214567	9·886549	436	10·113451	10·101116	162	9·898884	36	24
37	28	9·785597	273	10·214403	9·886810	435	10·113190	10·101213	162	9·898787	32	23
38	32	9·785761	273	10·214239	9·887072	435	10·112928	10·101311	162	9·898689	28	22
39	36	9·785925	273	10·214075	9·887333	435	10·112667	10·101408	162	9·898592	24	21
40	40	9·786089	273	10·213911	9·887594	435	10·112406	10·101506	163	9·898494	20	20
41	44	9·786252	272	10·213748	9·887855	435	10·112145	10·101603	163	9 898397	16	19
42	48	9·786416	272	10·213584	9·888116	435	10·111884	10·101701	163	9·898299	12	18
43	52	9·786579	272	10·213421	9·888377	435	10·111623	10·101798	163	9·898202	8	17
44	56	9·786742	272	10·213258	9·888639	435	10·111361	10·101896	163	9·898104	4	16
45	31	9·786906	272	10·213094	9·888900	435	10·111100	10·101994	163	9·898006	29	15
46	4	9·787069	272	10·212931	9·889160	435	10·110840	10·102092	163	9·897908	56	14
47	8	9·787232	271	10·212768	9·889421	435	10·110579	10·102190	163	9·897810	52	13
48	12	9·787395	271	10·212605	9·889682	435	10·110318	10·102288	163	9·897712	48	12
49	16	9·787557	271	10·212443	9·889943	435	10·110057	10·102386	163	9·897614	44	11
50	20	9·787720	271	10·212280	9·890204	435	10·109796	10·102484	163	9·897516	40	10
51	24	9·787883	271	10·212117	9·890465	435	10·109535	10·102582	164	9·897418	36	9
52	28	9·788045	271	10·211955	9·890725	434	10·109275	10·102680	164	9·897320	32	8
53	32	9·788208	271	10·211792	9·890986	434	10·109014	10·102778	164	9·897222	28	7
54	36	9·788370	270	10·211630	9·891247	434	10·108753	10·102877	164	9·897123	24	6
55	40	9·788532	270	10·211468	9·891507	434	10·108493	10·102975	164	9·897025	20	5
56	44	9·788694	270	10·211306	9·891768	434	10·108232	10·103074	164	9·896926	16	4
57	48	9·788856	270	10·211144	9·892028	434	10·107972	10·103172	164	9·896828	12	3
58	52	9·789018	270	10·210982	9·892289	434	10·107711	10·103271	164	9·896729	8	2
59	56	9·789180	270	10·210820	9·892549	434	10·107451	10·103369	164	9·896631	4	1
60	32	9·789342		10·210658	9·892810		10·107190	10·103468		9·896532	0	0
′		Co-sine.		Secant.	Co-tang.		Tangent.	Co-secant.		Sine.	s m	′

TABLE 5.

Logarithmic Sines, Tangents, and Secants.

2h. 32m. 38 Degrees.

′	m s	Sine.	Diff.	Co-secant.	Tangent.	Diff.	Co-tang.	Secant.	D.	Co-sine.		′
0	0	9·789342	269	10·210658	9·892810	434	10·107190	10·103468	164	9·896532	**28**	60
1	4	9·789504	269	10·210496	9·893070	434	10·106930	10·103567	165	9·896433	56	59
2	8	9·789665	269	10·210335	9·893331	434	10·106669	10·103665	165	9·896335	52	58
3	12	9·789827	269	10·210173	9·893591	434	10·106409	10·103764	165	9·896236	48	57
4	16	9·789988	269	10·210012	9·893851	434	10·106149	10·103863	165	9·896137	44	56
5	20	9·790149	269	10·209851	9·894111	434	10·105889	10·103962	165	9·896038	40	55
6	24	9·790310	268	10·209690	9·894371	434	10·105629	10·104061	165	9·895939	36	54
7	28	9·790471	268	10·209529	9·894632	434	10·105368	10·104160	165	9·895840	32	53
8	32	9·790632	268	10·209368	9·894892	433	10·105108	10·104259	165	9·895741	28	52
9	36	9·790793	268	10·209207	9·895152	433	10·104848	10·104359	165	9·895641	24	51
10	40	9·790954	268	10·209046	9·895412	433	10·104588	10·104458	165	9·895542	20	50
11	44	9·791115	268	10·208885	9·895672	433	10·104328	10·104557	166	9·895443	16	49
12	48	9·791275	267	10·208725	9·895932	433	10·104068	10·104657	166	9·895343	12	48
13	52	9·791436	267	10·208564	9·896192	433	10·103808	10·104756	166	9·895244	8	47
14	56	9·791596	267	10·208404	9·896452	433	10·103548	10·104855	166	9·895145	4	46
15	**33**	9·791757	267	10·208243	9·896712	433	10·103288	10·104955	166	9·895045	**27**	45
16	4	9·791917	267	10·208083	9·896971	433	10·103029	10·105055	166	9·894945	56	44
17	8	9·792077	267	10·207923	9·897231	433	10·102769	10·105154	166	9·894846	52	43
18	12	9·792237	266	10·207763	9·897491	433	10·102509	10·105254	166	9·894746	48	42
19	16	9·792397	266	10·207603	9·897751	433	10·102249	10·105354	166	9·894646	44	41
20	20	9·792557	266	10·207443	9·898010	433	10·101990	10·105454	166	9·894546	40	40
21	24	9·792716	266	10·207284	9·898270	433	10·101730	10·105554	167	9·894446	36	39
22	28	9·792876	266	10·207124	9·898530	433	10·101470	10·105654	167	9·894346	32	38
23	32	9·793035	266	10·206965	9·898789	433	10·101211	10·105754	167	9·894246	28	37
24	36	9·793195	265	10·206805	9·899049	432	10·100951	10·105854	167	9·894146	24	36
25	40	9·793354	265	10·206646	9·899308	432	10·100692	10·105954	167	9 894046	20	35
26	44	9·793514	265	10·206486	9·899568	432	10·100432	10·106054	167	9·893946	16	34
27	48	9·793673	265	10·206327	9·899827	432	10·100173	10·106154	167	9·893846	12	33
28	52	9·793832	265	10·206168	9·900086	432	10·099914	10·106255	167	9·893745	8	32
29	56	9·793991	265	10·206009	9·900346	432	10·099654	10·106355	167	9·893645	4	31
30	**34**	9·794150	264	10 205850	9·900605	432	10·099395	10·106456	167	9·893544	**26**	30
31	4	9·794308	264	10·205692	9·900864	432	10·099136	10·106556	168	9·893444	56	29
32	8	9·794467	264	10·205533	9·901124	432	10·098876	10·106657	168	9·893343	52	28
33	12	9·794626	264	10·205374	9·901383	432	10·098617	10·106757	168	9·893243	48	27
34	16	9·794784	264	10·205216	9·901642	432	10·098358	10·106858	168	9·893142	44	26
35	20	9·794942	264	10·205058	9·901901	432	10·098099	10·106959	168	9·893041	40	25
36	24	9·795101	264	10·204899	9·902160	432	10·097840	10·107060	168	9·892940	36	24
37	28	9·795259	263	10·204741	9·902419	432	10·097581	10·107161	168	9·892839	32	23
38	32	9·795417	263	10·204583	9·902679	432	10·097321	10·107261	168	9·892739	28	22
39	36	9·795575	263	10·204425	9·902938	432	10·097062	10·107362	168	9·892638	24	21
40	40	9·795733	263	10·204267	9·903197	432	10·096803	10·107464	168	9·892536	20	20
41	44	9·795891	263	10·204109	9·903455	431	10·096545	10·107565	169	9·892435	16	19
42	48	9·796049	263	10·203951	9·903714	431	10·096286	10·107666	169	9·892334	12	18
43	52	9·796206	263	10·203794	9·903973	431	10·096027	10·107767	169	9·892233	8	17
44	56	9·796364	262	10·203636	9·904232	431	10·095768	10·107868	169	9·892132	4	16
45	**35**	9·796521	262	10·203479	9·904491	431	10·095509	10·107970	169	9·892030	**25**	15
46	4	9·796679	262	10·203321	9·904750	431	10·095250	10·108071	169	9·891929	56	14
47	8	9·796836	262	10·203164	9·905008	431	10·094992	10·108173	169	9·891827	52	13
48	12	9·796993	262	10·203007	9·905267	431	10·094733	10·108274	169	9·891726	48	12
49	16	9·797150	262	10·202850	9·905526	431	10·094474	10·108376	169	9·891624	44	11
50	20	9·797307	261	10·202693	9·905784	431	10·094216	10·108477	169	9·891523	40	10
51	24	9·797464	261	10·202536	9·906043	431	10·093957	10·108579	170	9·891421	36	9
52	28	9·797621	261	10·202379	9·906302	431	10·093698	10·108681	170	9·891319	32	8
53	32	9·797777	261	10·202223	9·906560	431	10·093440	10·108783	170	9·891217	28	7
54	36	9·797934	261	10·202066	9·906819	431	10·093181	10·108885	170	9·891115	24	6
55	40	9·798091	261	10·201909	9·907077	431	10·092923	10·108987	170	9·891013	20	5
56	44	9·798247	261	10·201753	9·907336	431	10·092664	10·109089	170	9·890911	16	4
57	48	9·798403	260	10·201597	9·907594	431	10·092406	10·109191	170	9·890809	12	3
58	52	9·798560	260	10·201440	9·907852	431	10·092148	10·109293	170	9·890707	8	2
59	56	9·798716	260	10·201284	9·908111	431	10·091889	10·109395	170	9·890605	4	1
60	**36**	9·798872		10·201128	9·908369		10·091631	10·109497		9·890503	0	0
′		Co-sine.		Secant.	Co-tang.		Tangent.	Co-secant.		Sine.	s m	′

51 Degrees. 3h. 24m.

TABLE 5.

Logarithmic Sines, Tangents, and Secants.

2h. 36m. 39 Degrees.

′	m	Sine.	Diff.	Co-secant.	Tangent.	Diff.	Co-tang.	Secant.	D.	Co-sine.		′
0	0	9·798872	260	10·201128	9·908369	430	10·091631	10·109497	170	9·890503	24	60
1	4	9·799028	260	10·200972	9·908628	430	10·091372	10·109600	171	9·890400	56	59
2	8	9·799184	260	10·200816	9·908886	430	10·091114	10·109702	171	9·890298	52	58
3	12	9·799339	259	10·200661	9·909144	430	10·090856	10·109805	171	9·890195	48	57
4	16	9·799495	259	10·200505	9·909402	430	10·090598	10·109907	171	9·890093	44	56
5	20	9·799651	259	10·200349	9·909660	430	10·090340	10·110010	171	9·889990	40	55
6	24	9·799806	259	10·200194	9·909918	430	10·090082	10·110112	171	9·889888	36	54
7	28	9·799962	259	10·200038	9·910177	430	10·089823	10·110215	171	9·889785	32	53
8	32	9·800117	259	10·199883	9·910435	430	10·089565	10·110318	171	9·889682	28	52
9	36	9·800272	258	10·199728	9·910693	430	10·089307	10·110421	171	9·889579	24	51
10	40	9·800427	258	10·199573	9·910951	430	10·089049	10·110523	171	9·889477	20	50
11	44	9·800582	258	10·199418	9·911209	430	10·088791	10·110626	172	9·889374	16	49
12	48	9·800737	258	10·199263	9·911467	430	10·088533	10·110729	172	9·889271	12	48
13	52	9·800892	258	10·199108	9·911724	430	10·088276	10·110832	172	9·889168	8	47
14	56	9·801047	258	10·198953	9·911982	430	10·088018	10·110936	172	9·889064	4	46
15	37	9·801201	258	10·198799	9·912240	430	10·087760	10·111039	172	9·888961	23	45
16	4	9·801356	257	10·198644	9·912498	430	10·087502	10·111142	172	9·888858	56	44
17	8	9·801511	257	10·198489	9·912756	430	10·087244	10·111245	172	9·888755	52	43
18	12	9·801665	257	10·198335	9·913014	430	10·086986	10·111349	172	9·888651	48	42
19	16	9·801819	257	10·198181	9·913271	429	10·066729	10·111452	172	9·888548	44	41
20	20	9·801973	257	10·198027	9·913529	429	10·086471	10·111556	173	9·888444	40	40
21	24	9·802128	257	10·197872	9·913787	429	10·086213	10·111659	173	9·888341	36	39
22	28	9·802282	256	10·197718	9·914044	429	10·085956	10·111763	173	9·888237	32	38
23	32	9·802436	256	10·197564	9·914302	429	10·085698	10·111866	173	9·888134	28	37
24	36	9·802589	256	10·197411	9·914560	429	10·085440	10·111970	173	9·888030	24	36
25	40	9·802743	256	10·197257	9·914817	429	10·085183	10·112074	173	9·887926	20	35
26	44	9·802897	256	10·197103	9·915075	429	10·084925	10·112178	173	9·887822	16	34
27	48	9·803050	256	10·196950	9·915332	429	10·084668	10·112282	173	9·887718	12	33
28	52	9·803204	256	10·196796	9·915590	429	10·084410	10·112386	173	9·887614	8	32
29	56	9·803357	255	10·196643	9·915847	429	10·084153	10·112490	173	9·887510	4	31
30	38	9·803511	255	10·196489	9·916104	429	10·083896	10·112594	174	9·887406	22	30
31	4	9·803664	255	10·196336	9·916362	429	10·083638	10·112698	174	9·887302	56	29
32	8	9·803817	255	10·196183	9·916619	429	10·083381	10·112802	174	9·887198	52	28
33	12	9·803970	255	10·196030	9·916877	429	10·083123	10·112907	174	9·887093	48	27
34	16	9·804123	255	10·195877	9·917134	429	10·082866	10·113011	174	9·886989	44	26
35	20	9·804276	254	10·195724	9·917391	429	10·082609	10·113115	174	9·886885	40	25
36	24	9·804428	254	10·195572	9·917648	429	10·082352	10·113220	174	9·886780	36	24
37	28	9·804581	254	10·195419	9·917905	429	10·082095	10·113324	174	9·886676	32	23
38	32	9·804734	254	10·195266	9·918163	429	10·081837	10·113429	174	9·886571	28	22
39	36	9·804886	254	10·195114	9·918420	429	10·081580	10·113534	174	9·886466	24	21
40	40	9·805039	254	10·194961	9·918677	429	10·081323	10·113638	175	9·886362	20	20
41	44	9·805191	254	10·194809	9·918934	428	10·081066	10·113743	175	9·886257	16	19
42	48	9·805343	253	10·194657	9·919191	428	10·080809	10·113848	175	9·886152	12	18
43	52	9·805495	253	10·194505	9·919448	428	10·080552	10·113953	175	9·886047	8	17
44	56	9·805647	253	10·194353	9·919705	428	10·080295	10·114058	175	9·885942	4	16
45	39	9·805799	253	10·194201	9·919962	428	10·080038	10 114163	175	9·885837	21	15
46	4	9·805951	253	10·194049	9·920219	428	10·079781	10·114268	175	9·885732	56	14
47	8	9·806103	253	10·193897	9·920476	428	10·079524	10·114373	175	9·885627	52	13
48	12	9·806254	253	10·193746	9·920733	428	10·079267	10·114478	175	9·885522	48	12
49	16	9·806406	253	10·193594	9·920990	428	10·079010	10·114584	175	9·885416	44	11
50	20	9·806557	252	10·193443	9·921247	428	10·078753	10·114689	176	9·885311	40	10
51	24	9·806709	252	10·193291	9·921503	428	10·078497	10·114795	176	9·885205	36	9
52	28	9·806860	252	10·193140	9·921760	428	10·078240	10·114900	176	9·885100	32	8
53	32	9·807011	252	10·192989	9·922017	428	10·077983	10·115006	176	9·884994	28	7
54	36	9·807163	252	10·192837	9·922274	428	10·077726	10·115111	176	9·884889	24	6
55	40	9·807314	252	10·192686	9·922530	428	10·077470	10·115217	176	9·884783	20	5
56	44	9·807465	251	10·192535	9·922787	428	10·077213	10·115323	176	9·884677	16	4
57	48	9·807615	251	10·192385	9·923044	428	10·076956	10·115428	176	9·884572	12	3
58	52	9·807766	251	10·192234	9·923300	428	10 076700	10·115534	176	9·884466	8	2
59	56	9·807917	251	10·192083	9·923557	428	10·076443	10·115640	176	9·884360	4	1
60	40	9·808067		10·191933	9·923813		10·076187	10·115746		9·884254	0	0
′		Co-sine.		Secant.	Co-tang.		Tangent.	Co-secant.		Sine.	s m	′

50 Degrees. R 3h. 20m.

TABLE 5.

Logarithmic Sines, Tangents, and Secants.

2h. 40m. 40 Degrees.

′	m s	Sine.	Diff.	Co-secant.	Tangent.	Diff.	Co-tang.	Secant.	D.	Co-sine.		′
0	0	9·808067	251	10·191933	9·923813	428	10·076187	10·115746	177	9·884254	20	60
1	4	9·808218	251	10·191782	9·924070	428	10·075930	10·115852	177	9·884148	56	59
2	8	9·808368	251	10·191632	9·924327	428	10·075673	10·115958	177	9·884042	52	58
3	12	9·808519	250	10·191481	9·924583	427	10·075417	10·116064	177	9·883936	48	57
4	16	9·808669	250	10·191331	9·924840	427	10·075160	10·116171	177	9·883829	44	56
5	20	9·808819	250	10. 191181	9·925096	427	10·074904	10·116277	177	9·883723	40	55
6	24	9·808969	250	10·191031	9·925352	427	10·074648	10·116383	177	9·883617	36	54
7	28	9·809119	250	10·190881	9·925609	427	10·074391	10·116490	177	9·883510	32	53
8	32	9·809269	250	10·190731	9·925865	427	10·074135	10·116596	177	9·883404	28	52
9	36	9·809419	249	10·190581	9·926122	427	10·073878	10·116703	178	9·883297	24	51
10	40	9·809569	249	10·190431	9·926378	427	10. 073622	10·116809	178	9·883191	20	50
11	44	9·809718	249	10·190282	9·926634	427	10·073366	10·116916	178	9·883084	16	49
12	48	9·809868	249	10·190132	9·926890	427	10·073110	10·117023	178	9·882977	12	48
13	52	9·810017	249	10·189983	9·927147	427	10·072853	10·117129	178	9·882871	8	47
14	56	9·810167	249	10·189833	9·927403	427	10·072597	10·117236	178	9·882764	4	46
15	41	9·810316	248	10·189684	9·927659	427	10·072341	10·117343	178	9·882657	19	45
16	4	9·810465	248	10·189535	9·927915	427	10·072085	10·117450	178	9·882550	56	44
17	8	9·810614	248	10·189386	9·928171	427	10·071829	10·117557	178	9·882443	52	43
18	12	9·810763	248	10·189237	9·928427	427	10·071573	10·117664	179	9·882336	48	42
19	16	9·810912	248	10·189088	9·928683	427	10·071317	10·117771	179	9·882229	44	41
20	20	9·811061	248	10·188939	9·928940	427	10·071060	10·117879	179	9·882121	40	40
21	24	9·811210	248	10·188790	9·929196	427	10·070804	10·117986	179	9·882014	36	39
22	28	9·811358	247	10·188642	9·929452	427	10·070548	10·118093	179	9·881907	32	38
23	32	9·811507	247	10·188493	9·929708	427	10·070292	10·118201	179	9·881799	28	37
24	36	9·811655	247	10·188345	9·929964	427	10·070036	10·118308	179	9·881692	24	36
25	40	9·811804	247	10·188196	9·930220	427	10·069780	10·118416	179	9·861584	20	35
26	44	9·811952	247	10·188048	9·930475	427	10·069525	10·118523	179	9·881477	16	34
27	48	9·812100	247	10·187900	9·930731	426	10·069269	10·118631	179	9·881369	12	33
28	52	9·812248	247	10·187752	9·930987	426	10·069013	10·118739	180	9·881261	8	32
29	56	9·812396	246	10·187604	9·931243	426	10·068757	10·118847	180	9·881153	4	31
30	42	9·812544	246	10·187456	9·931499	426	10·068501	10·118954	180	9·881046	18	30
31	4	9·812692	246	10·187308	9·931755	426	10·068245	10·119062	180	9·880938	56	29
32	8	9·812840	246	10·187160	9·932010	426	10·067990	10·119170	180	9·880830	52	28
33	12	9·812988	246	10·187012	9·932266	426	10·067734	10·119278	180	9·880722	48	27
34	16	9·813135	246	10·186865	9·932522	426	10·067478	10·119387	180	9·880613	44	26
35	20	9·813283	246	10·186717	9·932778	426	10·067222	10·119495	180	9·880505	40	25
36	24	9·813430	245	10·186570	9·933033	426	10·066967	10·119603	180	9·880397	36	24
37	28	9·813578	245	10·186422	9·933289	426	10·066711	10·119711	181	9·880289	32	23
38	32	9·813725	245	10·186275	9 933545	426	10·066455	10·119820	181	9·880180	28	22
39	36	9·813872	245	10·186128	9·933800	426	10·066200	10·119928	181	9·880072	24	21
40	40	9·814019	245	10·185981	9·934056	426	10·065944	10·120037	181	9·879963	20	20
41	44	9·814166	245	10·185834	9·934311	426	10·065689	10·120145	181	9·879855	16	19
42	48	9·814313	245	10·185687	9·934567	426	10·065433	10·120254	181	9·879746	12	18
43	52	9·814460	244	10·185540	9·934823	426	10·065177	10·120363	181	9·879637	8	17
44	56	9·814607	244	10·185393	9·935078	426	10·064922	10·120471	181	9·879529	4	16
45	43	9·814753	244	10·185247	9·935333	426	10·064667	10·120580	181	9·879420	17	15
46	4	9·814900	244	10·185100	9·935589	426	10·064411	10·120689	181	9·879311	56	14
47	8	9·815046	244	10·184954	9·935844	426	10·064156	10·120798	182	9·879202	52	13
48	12	9·815193	244	10·184807	9·936100	426	10·063900	10·120907	182	9·879093	48	12
49	16	9·815339	244	10·184661	9·936355	426	10·063645	10·121016	182	9·878984	44	11
50	20	9·815485	243	10·184515	9·936610	426	10·063390	10·121125	182	9·878875	40	10
51	24	9·815632	24[illegible]	[illegible]·184368	9·936866	426	10·063134	10·121234	182	9·878766	36	9
52	28	9·815778	24[illegible]	10·184222	9·937121	426	10·062879	10·121344	182	9·878656	32	8
53	32	9·815924	243	10·184076	9·937376	425	10·0626[illegible]	10·121453	182	9·878547	28	7
54	36	9·816069	243	10·183931	9·937632	425	10·062368	10·121562	182	9·878438	24	6
55	40	9·816215	243	10·183785	9·937887	425	10·062113	10·121672	182	9·878328	20	5
56	44	9·816361	243	10·183639	9·938142	425	10·061858	10·121781	183	9·878219	16	4
57	48	9·816507	242	10·183493	9·938398	425	10·061602	10·121891	183	9·878109	12	3
58	52	9·816652	242	10·183348	9·938653	425	10·061347	10·122001	183	9·877999	8	2
59	56	9·816798	242	10·183202	9·938908	425	10·061092	10·122110	183	9·877890	4	1
60	44	9·816943		10·183057	9·939163		10·060837	10·122220		9·877780	0	0
′		Co-sine.		Secant.	Co-tang.		Tangent.	Co-secant.		Sine.	s m	′

49 Degrees. 3h. 16m.

TABLE 5.

Logarithmic Sines, Tangents, and Secants.

2h. 44m. 41 Degrees.

′	m s	Sine.	Diff.	Co-secant.	Tangent.	Diff.	Co-tang.	Secant.	D.	Co-sine.	s	′
0	0	9·816943	242	10·183057	9·939163	425	10·060837	10·122220	183	9·877780	16	60
1	4	9·817088	242	10·182912	9·939418	425	10·060582	10·122330	183	9·877670	56	59
2	8	9·817233	242	10·182767	9·939673	425	10·060327	10·122440	183	9·877560	52	58
3	12	9·817379	242	10·182621	9·939928	425	10·060072	10·122550	183	9·877450	48	57
4	16	9·817524	241	10·182476	9·940183	425	10·059817	10·122660	183	9·877340	44	56
5	20	9·817668	241	10·182332	9·940438	425	10·059562	10·122770	184	9·877230	40	55
6	24	9·817813	241	10·182187	9·940694	425	10·059306	10·122880	184	9·877120	36	54
7	28	9·817958	241	10·182042	9·940949	425	10·059051	10·122990	184	9·877010	32	53
8	32	9·818103	241	10·181897	9·941204	425	10·058796	10·123101	184	9·876899	28	52
9	36	9·818247	241	10·181753	9·941458	425	10·058542	10·123211	184	9·876789	24	51
10	40	9·818392	241	10·181608	9·941714	425	10·058286	10·123322	184	9·876678	20	50
11	44	9·818536	240	10·181464	9·941968	425	10·058032	10·123432	184	9·876568	16	49
12	48	9·818681	240	10·181319	9·942223	425	10·057777	10·123543	184	9 876457	12	48
13	52	9·818825	240	10·181175	9·942478	425	10·057522	10·123653	184	9·876347	8	47
14	56	9·818969	240	10·181031	9·942733	425	10·057267	10·123764	185	9·876236	4	46
15	45	9·819113	240	10·180887	9·942988	425	10 057012	10·123875	185	9·876125	15	45
16	4	9·819257	240	10·180743	9·943243	425	10·056757	10·123986	185	9·876014	56	44
17	8	9·819401	240	10·180599	9·943498	425	10·056502	10·124096	185	9·875904	52	43
18	12	9·819545	239	10·180455	9·943752	425	10·056248	10·124207	185	9·875793	48	42
19	16	9·819689	239	10·180311	9·944007	425	10·055993	10·124318	185	9·875682	44	41
20	20	9·819832	239	10·180168	9·944262	425	10·055738	10·124429	185	9·875571	40	40
21	24	9·819976	239	10·180024	9·944517	425	10·055483	10·124541	185	9·875459	36	39
22	28	9·820120	239	10·179880	9·944771	425	10·055229	10·124652	185	9·875348	32	38
23	32	9·820263	239	10·179737	9·945026	425	10·054974	10·124763	185	9·875237	28	37
24	36	9:820406	239	10·179594	9·945281	425	10·054719	10·124874	186	9·875126	24	36
25	40	9·820550	238	10·179450	9·945535	425	10·054465	10·124986	186	9·875014	20	35
26	44	9·820693	238	10·179307	9·945790	425	10·054210	10·125097	186	9·874903	16	34
27	48	9·820836	238	10·179164	9·946045	425	10·053955	10·125209	186	9·874791	12	33
28	52	9·820979	238	10·179021	9·946299	425	10·053701	10·125320	186	9·874680	8	32
29	56	9·821122	238	10·178878	9·946554	425	10·053446	10·125432	186	9·874568	4	31
30	46	9·821265	238	10·178735	9·946808	425	10·053192	10·125544	186	9·874456	14	30
31	4	9·821407	238	10·178593	9·947063	424	10·052937	10·125656	186	9·874344	56	29
32	8	9·821550	238	10·178450	9·947318	424	10·052682	10·125768	186	9·874232	52	28
33	12	9·821693	237	10·178307	9·947572	424	10·052428	10·125879	187	9·874121	48	27
34	16	9·821835	237	10·178165	9·947826	424	10·052174	10·125991	187	9·874009	44	26
35	20	9·821977	237	10·178023	9·948081	424	10·051919	10·126104	187	9·873896	40	25
36	24	9·822120	237	10·177880	9·948336	424	10·051664	10·126216	187	9·873784	36	24
37	28	9·822262	237	10·177738	9·948590	424	10·051410	10·126328	187	9·873672	32	23
38	32	9·822404	237	10·177596	9·948844	424	10·051156	10·126440	187	9·873560	28	22
39	36	9·822546	237	10·177454	9·949099	424	10·050901	10·126552	187	9·873448	24	21
40	40	9·822688	236	10·177312	9·949353	424	10·050647	10·126665	187	9·873335	20	20
41	44	9·822830	236	10·177170	9·949607	424	10·050393	10·126777	187	9·873223	16	19
42	48	9·822972	236	10·177028	9·949862	424	10·050138	10·126890	188	9·873110	12	18
43	52	9·823114	236	10·176886	9·950116	424	10·049884	10·127002	188	9·872998	8	17
44	56	9·823255	236	10·176745	9·950370	424	10·049630	10·127115	188	9·872885	4	16
45	47	9·823397	236	10·176603	9·950625	424	10·049375	10·127228	188	9·872772	13	15
46	4	9·823539	236	10·176461	9·950879	424	10·049121	10·127341	188	9·872659	56	14
47	8	9·823680	235	10·176320	9·951133	424	10·048867	10·127453	188	9·872547	52	13
48	12	9·823821	235	10·176179	9·951388	424	10·048612	10·127566	188	9·872434	48	12
49	16	9·823963	235	10·176037	9·951642	424	10·048358	10·127679	188	9·872321	44	11
50	20	9·824104	235	10·175896	9·951896	424	10·048104	10·127792	188	9·872208	40	10
51	24	9·824245	235	10·175755	9·952150	424	10·047850	10·127905	189	9·872095	36	9
52	28	9·824386	235	10·175614	9·952405	424	10·047595	10·128019	189	9·871981	32	8
53	32	9·824527	235	10·175473	9·952659	424	10·047341	10·128132	189	9 871868	28	7
54	36	9·824668	234	10·175332	9. 952913	424	10·047087	10·128245	189	9·871755	24	6
55	40	9·824808	234	10·175192	9·953167	423	10·046833	10·128359	189	9·871641	20	5
56	44	9·824949	234	10·175051	9·953421	423	10·046579	10·128472	189	9·871528	16	4
57	48	9·825090	234	10·174910	9·953675	423	10·046325	10·128586	189	9·871414	12	3
58	52	9·825230	234	10·174770	9·953929	423	10·046071	10·128699	189	9 871301	8	2
59	56	9·825371	234	10·174629	9·954183	423	10·045817	10·128813	189	9·871187	4	1
60	48	9·825511		10·174489	9·954437		10·045563	10·128927		9·871073	0	0
′		Co-sine.		Secant.	Co-tang.		Tangent.	Co-secant.		Sine.	s m	′

TABLE 5

Logarithmic Sines, Tangents, and Secants.

2h. 48m. 42 Degrees.

′	m s	Sine.	Diff.	Co-secant.	Tangent.	Diff.	Co-tang·	Secant.	D.	Co-sine.		′
0	0	9·825511	234	10·174489	9·954437	423	10·045563	10·128927	190	9·871073	12	60
1	4	9·825651	233	10·174349	9·954691	423	10·045309	10·129040	190	9·870960	56	59
2	8	9·825791	233	10·174209	9·954945	423	10·045055	10·129154	190	9·870846	52	58
3	12	9·825931	233	10·174069	9·955200	423	10·044800	10·129268	190	9·870732	48	57
4	16	9·826071	233	10·173929	9·955454	423	10·044546	10·129382	190	9·870618	44	56
5	20	9·826211	233	10·173789	9·955707	423	10·044293	10·129496	190	9·870504	40	55
6	24	9·826351	233	10·173649	9·955961	423	10·044039	10·129610	190	9·870390	36	54
7	28	9·826491	233	10·173509	9·956215	423	10·043785	10·129724	190	9·870276	32	53
8	32	9·826631	233	10·173369	9·956469	423	10·043531	10·129839	190	9·870161	28	52
9	36	9·826770	232	10·173230	9·956723	423	10·043277	10·129953	191	9·870047	24	51
10	40	9·826910	232	10·173090	9·956977	423	10·043023	10·130067	191	9·869933	20	50
11	44	9·827049	232	10·172951	9·957231	423	10·042769	10·130182	191	9·869818	16	49
12	48	9·827189	232	10·172811	9·957485	423	10·042515	10·130296	191	9·869704	12	48
13	52	9·827328	232	10·172672	9·957739	423	10·042261	10·130411	191	9·869589	8	47
14	56	9·827467	232	10·172533	9·957993	423	10·042007	10·130526	191	9·869474	4	46
15	49	9·827606	232	10·172394	9·958246	423	10·041754	10·130640	191	9·869360	11	45
16	4	9·827745	232	10·172255	9·958500	423	10·041500	10·130755	191	9·869245	56	44
17	8	9·827884	231	10·172116	9·958754	423	10·041246	10·130870	191	9·869130	52	43
18	12	9·828023	231	10·171977	9·959008	423	10·040992	10·130985	192	9·869015	48	42
19	16	9·828162	231	10·171838	9·959262	423	10·040738	10·131100	192	9·868900	44	41
20	20	9·828301	231	10·171699	9·959516	423	10·040484	10·131215	192	9·868785	40	40
21	24	9·828439	231	10·171561	9·959769	423	10·040231	10·131330	192	9·868670	36	39
22	28	9·828578	231	10·171422	9·960023	423	10·039977	10·131445	192	9·868555	32	38
23	32	9·828716	231	10·171284	9·960277	423	10·039723	10·131560	192	9·868440	28	37
24	36	9·828855	230	10·171145	9·960531	423	10·039469	10·131676	192	9·868324	24	36
25	40	9·828993	230	10·171007	9·960784	423	10·039216	10·131791	192	9·868209	20	35
26	44	9·829131	230	10·170869	9·961038	423	10·038962	10·131907	192	9·868093	16	34
27	48	9·829269	230	10 170731	9·961291	423	10·038709	10·132022	193	9·867978	12	33
28	52	9·829407	230	10·170593	9·961545	423	10·038455	10·132138	193	9·867862	8	32
29	56	9·829545	230	10·170455	9·961799	423	10·038201	10·132253	193	9·867747	4	31
30	50	9·829683	230	10·170317	9·962052	423	10·037948	10·132369	193	9·867631	10	30
31	4	9·829821	229	10·170179	9·962306	423	10·037694	10·132485	193	9·867515	56	29
32	8	9·829959	229	10·170041	9·962560	423	10·037440	10·132601	193	9·867399	52	28
33	12	9·830097	229	10·169903	9·962813	423	10·037187	10·132717	193	9·867283	48	27
34	16	9·830234	229	10·169766	9·963067	423	10·036933	10·132833	193	9·867167	44	26
35	20	9·830372	229	10·169628	9·963320	423	10·036680	10·132949	193	9·867051	40	25
36	24	9·830509	229	10·169491	9·963574	423	10·036426	10·133065	194	9·866935	36	24
37	28	9·830646	229	10·169354	9·963827	423	10·036173	10·133181	194	9·866819	32	23
38	32	9·830784	229	10·169216	9·964081	423	10·035919	10·133297	194	9·866703	28	22
39	36	9·830921	228	10·169079	9·964335	423	10·035665	10·133414	194	9·866586	24	21
40	40	9·831058	228	10·168942	9·964588	423	10·035412	10·133530	194	9·866470	20	20
41	44	9·831195	228	10·168805	9·964842	422	10·035158	10·133647	194	9·866353	16	19
42	48	9·831332	228	10·168668	9·965095	422	10·034905	10·133763	194	9·866237	12	18
43	52	9·831469	228	10·168531	9·965349	422	10·034651	10·133880	194	9·866120	8	17
44	56	9·831606	228	10·168394	9·965602	422	10·034398	10·133996	195	9·866004	4	16
45	51	9·831742	228	10·168258	9·965855	422	10·034145	10·134113	195	9·865887	9	15
46	4	9·831879	228	10·168121	9·966109	422	10·033891	10·134230	195	9·865770	56	14
47	8	9·832015	227	10·167985	9·966362	422	10·033638	10·134347	195	9·865653	52	13
48	12	9·832152	227	10·167848	9·966616	422	10·033384	10·134464	195	9·865536	48	12
49	16	9·832288	227	10·167712	9 966869	422	10·033131	10·134581	195	9·865419	44	11
50	20	9·832425	227	10·167575	9·967123	422	10·032877	10·134698	195	9·865302	40	10
51	24	9·832561	227	10·167439	9·967376	422	10·032624	10·134815	195	9·865185	36	9
52	28	9·832697	227	10·167303	9·967629	422	10·032371	10·134932	195	9·865068	32	8
53	32	9·832833	227	10·167167	9·967883	422	10·032117	10·135050	195	9·864950	28	7
54	36	9·832969	226	10·167031	9·968136	422	10·031864	10·135167	196	9·864833	24	6
55	40	9·833105	226	10·166895	9·968389	422	10·031611	10·135284	196	9·864716	20	5
56	44	9·833241	226	10·166759	9·968643	422	10·031357	10·135402	196	9·864598	16	4
57	48	9·833377	226	10·166623	9·968896	422	10·031104	10·135519	196	9·864481	12	3
58	52	9·833512	226	10·166488	9·969149	422	10·030851	10·135637	196	9·864363	8	2
59	56	9·833648	226	10·166352	9·969403	422	10·030597	10·135755	196	9·864245	4	1
60	52	9·833783		10·166217	9·969656		10·030344	10·135873		9·864127	8	0
′		Co-sine.		Secant.	Co-tang.		Tangent.	Co-secant.		Sine.	s m	′

47 Degrees

TABLE 5.

Logarithmic Sines, Tangents, and Secants.

2h. 52m. 43 Degrees.

′	m s	Sine.	Diff.	Co-secant.	Tangent.	Diff.	Co-tang.	Secant.	D.	Co-sine.		′
0	0	9·833783	226	10·166217	9·969656	422	10·030344	10·135873	196	9·864127	8	60
1	4	9·833919	225	10·166081	9·969909	422	10·030091	10·135990	196	9·864010	56	59
2	8	9·834054	225	10·165946	9·970162	422	10·029838	10·136108	197	9·863892	52	58
3	12	9·834189	225	10·165811	9·970416	422	10·029584	10·136226	197	9·863774	48	57
4	16	9·834325	225	10·165675	9·970669	422	10·029331	10·136344	197	9·863656	44	56
5	20	9·834460	225	10·165540	9·970922	422	10·029078	10·136462	197	9·863538	40	55
6	24	9·834595	225	10·165405	9·971175	422	10·028825	10·136581	197	9·863419	36	54
7	28	9·834730	225	10·165270	9·971429	422	10·028571	10·136699	197	9·863301	32	53
8	32	9·834865	225	10·165135	9·971682	422	10·028318	10·136817	197	9·863183	28	52
9	36	9·834999	224	10·165001	9·971935	422	10·028065	10·136936	197	9·863064	24	51
10	40	9·835134	224	10·164866	9·972188	422	10·027812	10·137054	198	9·862946	20	50
11	44	9·835269	224	10·164731	9·972441	422	10·027559	10·137173	198	9·862827	16	49
12	48	9·835403	224	10·164597	9·972694	422	10·027306	10·137291	198	9·862709	12	48
13	52	9·835538	224	10·164462	9·972948	422	10·027052	10·137410	198	9·862590	8	47
14	56	9·835672	224	10·164328	9·973201	422	10·026799	10·137529	198	9·862471	4	46
15	53	9·835807	224	10·164193	9·973454	422	10·026546	10·137647	198	9·862353	7	45
16	4	9·835941	224	10·164059	9·973707	422	10·026293	10·137766	198	9·862234	56	44
17	8	9·836075	223	10·163925	9·973960	422	10·026040	10·137885	198	9·862115	52	43
18	12	9·836209	223	10·163791	9·974213	422	10·025787	10·138004	198	9·861996	48	42
19	16	9·836343	223	10·163657	9·974466	422	10·025534	10·138123	198	9·861877	44	41
20	20	9·836477	223	10·163523	9·974719	422	10·025281	10·138242	199	9·861758	40	40
21	24	9·836611	223	10·163389	9·974973	422	10·025027	10·138362	199	9·861638	36	39
22	28	9·836745	223	10·163255	9·975226	422	10·024774	10·138481	199	9·861519	32	38
23	32	9·836878	223	10·163122	9·975479	422	10·024521	10·138600	199	9·861400	28	37
24	36	9·837012	222	10·162988	9·975732	422	10·024268	10·138720	199	9·861280	24	36
25	40	9·837146	222	10·162854	9·975985	422	10·024015	10·138839	199	9·861161	20	35
26	44	9·837279	222	10·162721	9·976238	422	10·023762	10·138959	199	9·861041	16	34
27	48	9·837412	222	10·162588	9·976491	422	10·023509	10·139078	199	9·860922	12	33
28	52	9·837546	222	10·162454	9·976744	422	10·023256	10·139198	199	9·860802	8	32
29	56	9·837679	222	10·162321	9·976997	422	10·023003	10·139318	200	9·860682	4	31
30	54	9·837812	222	10·162188	9·977250	422	10·022750	10·139438	200	9·860562	6	30
31	4	9·837945	222	10·162055	9·977503	422	10·022497	10·139558	200	9·860442	56	29
32	8	9·838078	221	10·161922	9·977756	422	10·022244	10·139678	200	9·860322	52	28
33	12	9·838211	221	10·161789	9·978009	422	10·021991	10·139798	200	9·860202	48	27
34	16	9·838344	221	10·161656	9·978262	422	10·021738	10·139918	200	9·860082	44	26
35	20	9·838477	221	10·161523	9·978515	422	10·021485	10·140038	200	9·859962	40	25
36	24	9·838610	221	10·161390	9·978768	422	10·021232	10·140158	200	9·859842	36	24
37	28	9·838742	221	10·161258	9·979021	422	10·020979	10·140279	201	9·859721	32	23
38	32	9·838875	221	10·161125	9·979274	422	10·020726	10·140399	201	9·859601	28	22
39	36	9·839007	221	10·160993	9·979527	422	10·020473	10·140520	201	9·859480	24	21
40	40	9·839140	220	10·160860	9·979780	422	10·020220	10·140640	201	9·859360	20	20
41	44	9·839272	220	10·160728	9·980033	422	10·019967	10·140761	201	9·859239	16	19
42	48	9·839404	220	10·160596	9·980286	422	10·019714	10·140881	201	9·859119	12	18
43	52	9·839536	220	10·160464	9·980538	422	10·019462	10·141002	201	9·858998	8	17
44	56	9·839668	220	10·160332	9·980791	422	10·019209	10·141123	201	9·858877	4	16
45	55	9·839800	220	10·160200	9·981044	422	10·018956	10·141244	202	9·858756	5	15
46	4	9·839932	220	10·160068	9·981297	422	10·018703	10·141365	202	9·858635	56	14
47	8	9·840064	219	10·159936	9·981550	422	10·018450	10·141486	202	9·858514	52	13
48	12	9·840196	219	10·159804	9·981803	422	10·018197	10·141607	202	9·858393	48	12
49	16	9·840328	219	10·159672	9·982056	422	10·017944	10·141728	202	9·858272	44	11
50	20	9·840459	219	10·159541	9·982309	421	10·017691	10·141849	202	9·858151	40	10
51	24	9·840591	219	10·159409	9·982562	421	10·017438	10·141971	202	9·858029	36	9
52	28	9·840722	219	10·159278	9·982814	421	10·017186	10·142092	202	9·857908	32	8
53	32	9·840854	219	10·159146	9·983067	421	10·016933	10·142214	202	9·857786	28	7
54	36	9·840985	219	10·159015	9·983320	421	10·016680	10·142335	203	9·857665	24	6
55	40	9·841116	218	10·158884	9·983573	421	10·016427	10·142457	203	9·857543	20	5
56	44	9·841247	218	10·158753	9·983826	421	10·016174	10·142578	203	9·857422	16	4
57	48	9·841378	218	10·158622	9·984079	421	10·015921	10·142700	203	9·857300	12	3
58	52	9·841509	218	10·158491	9·984331	421	10·015669	10·142822	203	9·857178	8	2
59	56	9·841640	218	10·158360	9·984584	421	10·015416	10·142944	203	9·857056	4	1
60	56	9·841771		10·158229	9·984837		10·015163	10·143066		9·856934	0	0
′		Co-sine.		Secant.	Co-tang.		Tangent.	Co-secant.		Sine.	s m	′

TABLE 5.

Logarithmic Sines, Tangents, and Secants.

2h. 56m. 44 Degrees.

′	m s	Sine.	Diff.	Co-secant.	Tangent.	Diff.	Co-tang.	Secant.	D.	Co-sine.		′
0	0	9·841771	218	10·158229	9·984837	421	10·015163	10·143066	203	9·856934	4	60
1	4	9·841902	218	10·158098	9·985090	421	10·014910	10·143188	203	9·856812	56	59
2	8	9·842033	218	10·157967	9·985343	421	10·014657	10·143310	204	9·856690	52	58
3	12	9·842163	217	10·157837	9·985596	421	10·014404	10·143432	204	9·856568	48	57
4	16	9·842294	217	10·157706	9·985848	421	10·014152	10·143554	204	9·856446	44	56
5	20	9·842424	217	10·157576	9·986101	421	10·013899	10·143677	204	9·856323	40	55
6	24	9·842555	217	10·157445	9·986354	421	10·013646	10·143799	204	9·856201	36	54
7	28	9·842685	217	10·157315	9·986607	421	10·013393	10·143922	204	9·856078	32	53
8	32	9·842815	217	10·157185	9·986860	421	10·013140	10·144044	204	9·855956	28	52
9	36	9·842946	217	10·157054	9·987112	421	10·012888	10·144167	204	9·855833	24	51
10	40	9·843076	217	10·156924	9·987365	421	10·012635	10·144289	205	9·855711	20	50
11	44	9·843206	216	10·156794	9·987619	421	10. 012382	10·144412	205	9·855588	16	49
12	48	9·843336	216	10·156664	9·987871	421	10·012129	10·144535	205	9·855465	12	48
13	52	9·843466	216	10·156534	9·988123	421	10·011877	10·144658	205	9·855342	8	47
14	56	9·843595	216	10·156405	9·988376	421	10·011624	10·144781	205	9·855219	4	46
15	57	9·843725	216	10·156275	9·988629	421	10·011371	10·144904	205	9·855096	3	45
16	4	9·843855	216	10·156145	9·988882	421	10·011118	10·145027	205	9·854973	56	44
17	8	9·843984	216	10·156016	9·989134	421	10·010866	10·145150	205	9·854850	52	43
18	12	9·844114	216	10·155886	9·989387	421	10·010613	10·145273	206	9·854727	48	42
19	16	9·844243	215	10·155757	9·989640	421	10·010360	10·145397	206	9·854603	44	41
20	20	9·844372	215	10·155628	9·989893	421	10·010107	10 145520	206	9·854480	40	40
21	24	9·844502	215	10·155498	9·990145	421	10·009855	10·145644	206	9·854356	36	39
22	28	9·844631	215	10·155369	9·990398	421	10·009602	10·145767	206	9·854233	32	38
23	32	9·844760	215	10·155240	9·990651	421	10·009349	10·145891	206	9·854109	28	37
24	36	9·844889	215	10·155111	9·990903	421	10·009097	10·146014	206	9·853986	24	36
25	40	9 845018	215	10·154982	9·991156	421	10·008844	10·146138	206	9·853862	20	35
26	44	9·845147	215	10·154853	9·991409	421	10·008591	10·146262	206	9·853738	16	34
27	48	9·845276	214	10·154724	9·991662	421	10·008338	10·146386	207	9·853614	12	33
28	52	9·845405	214	10·154595	9·991914	421	10·008086	10·146510	207	9·853490	8	32
29	56	9·845533	214	10·154467	9·992167	421	10 007833	10·146634	207	9·853366	4	31
30	58	9·845662	214	10·154338	9·992420	421	10·007580	10·146758	207	9 853242	2	30
31	4	9·845790	214	10·154210	9·992672	421	10·007328	10·146882	207	9·853118	56	29
32	8	9·845919	214	10·154081	9·992925	421	10·007075	10·147006	207	9·852994	52	28
33	12	9·846047	214	10·153953	9·993178	421	10·006822	10·147131	207	9·852869	48	27
34	16	9·846175	214	10·153825	9·993430	421	10·006570	10·147255	207	9·852745	44	26
35	20	9·846304	214	10·153696	9·993683	421	10·006317	10·147380	207	9·852620	40	25
36	24	9·846432	213	10·153568	9·993936	421.	10·006064	10·147504	208	9·852496	36	24
37	28	9·846560	213	10·153440	9·994189	421	10·005811	10·147629	208	9·852371	32	23
38	32	9·846688	213	10·153312	9·994441	421	10·005559	10·147753	208	9·852247	28	22
39	36	9·846816	213	10·153184	9·994694	421	10·005306	10·147878	208	9·852122	24	21
40	40	9·846944	213	10·153056	9·994947	421	10·005053	10·148003	208	9·851997	20	20
41	44	9·847071	213	10·152929	9·995199	421	10·004801	10·148128	208	9·851872	16	19
42	48	9·847199	213	10·152801	9·995452	421	10·004548	10·148253	208	9·851747	12	18
43	52	9·847327	213	10·152673	9·995705	421	10·004295	10·148378	208	9·851622	8	17
44	56	9·847454	212	10·152546	9·995957	421	10·004043	10·148503	209	9·851497	4	16
45	59	9·847582	212	10·152418	9·996210	421	10·003790	10·148628	209	9·851372	1	15
46	4	9·847709	212	10·152291	9·996463	421	10·003537	10·148754	209	9·851246	56	14
47	8	9·847836	212	10·152164	9·996715	421	10·003285	10·148879	209	9·851121	52	13
48	12	9·847964	212	10·152036	9·996968	421	10·003032	10·149004	209	9·850996	48	12
49	16	9·848091	212	10·151909	9·997221	421	10·002779	10·149130	209	9·850870	44	11
50	20	9·848218	212	10·151782	9·997473	421	10·002527	10·149255	209	9·850745	40	10
51	24	9·848345	212	10·151655	9·997726	421	10·002274	10·149381	209	9·850619	36	9
52	28	9·848472	211	10·151528	9·997979	421	10·002021	10·149507	210	9·850493	32	8
53	32	9·848599	211	10·151401	9·998231	421	10·001769	10·149632	210	9·850368	28	7
54	36	9·848726	211	10·151274	9·998484	421	10·001516	10·149758	210	9·850242	24	6
55	40	9·848852	211	10·151148	9·998737	421	10·001263	10·149884	210	9·850116	20	5
56	44	9·848979	211	10·151021	9·998989	421	10·001011	10·150010	210	9 849990	16	4
57	48	9·849106	211	10·150894	9·999242	421	10·000758	10·150136	210	9·849864	12	3
58	52	9·849232	211	10·150768	9·999495	421	10·000505	10·150262	210	9·849738	8	2
59	56	9·849359	211	10·150641	9·999747	421	10·000253	10·150389	210	9·849611	4	1
60	60	9·849485		10·150515	.0·000000		10·000000	10·150515		9·849485	0	0
′		Co-sine.		Secant.	Co-tang.		Tangent.	Co-secant.		Sine.	s m	′

45 Degrees. 3h. 0m.

TABLE 6.

Meridional Parts.

′	0°	1°	2°	3°	4°	5°	6°	7°	8°	9°	10°	11°	12°	13°	14°	15°	′
0	0	60	120	180	240	300	361	421	482	542	603	664	725	787	849	910	0
1	1	61	121	181	241	301	362	422	483	543	604	665	726	788	850	912	1
2	2	62	122	182	242	302	363	423	484	544	605	666	727	789	851	913	2
3	3	63	123	183	243	303	364	424	485	545	606	667	728	790	852	914	3
4	4	64	124	184	244	304	365	425	486	546	607	668	729	791	853	915	4
5	5	65	125	185	245	305	366	426	487	547	608	669	730	792	854	916	5
6	6	66	126	186	246	306	367	427	488	548	609	670	731	793	855	917	6
7	7	67	127	187	247	307	368	428	489	549	610	671	732	794	856	918	6
8	8	68	128	188	248	308	369	429	490	550	611	672	734	795	857	919	8
9	9	69	129	189	249	309	370	430	491	551	612	673	735	796	858	920	9
10	10	70	130	190	250	310	371	431	492	552	613	674	736	797	859	921	10
11	11	71	131	191	251	311	372	432	493	553	614	675	737	798	860	922	11
12	12	72	132	192	252	312	373	483	494	554	615	676	738	799	861	923	12
13	13	73	133	193	253	313	374	434	495	555	616	677	739	800	862	924	13
14	14	74	134	194	254	314	375	435	496	556	617	678	740	801	863	925	14
15	15	75	135	195	255	315	376	436	497	557	618	679	741	802	864	926	15
16	16	76	136	196	256	316	377	437	498	558	619	680	742	803	865	927	16
17	17	77	137	197	257	317	378	438	499	559	620	681	743	804	866	928	17
18	18	78	138	198	258	318	379	439	500	560	621	682	744	805	867	929	18
19	19	79	139	199	259	319	380	440	501	561	622	683	745	806	868	930	19
20	20	80	140	200	260	320	381	441	502	562	623	684	746	807	869	931	20
21	21	81	141	201	261	321	382	442	503	564	624	685	747	808	870	932	21
22	22	82	142	202	262	322	383	443	504	565	625	687	748	809	871	933	22
23	23	83	143	203	263	323	384	444	505	566	626	688	749	810	872	934	23
24	24	84	144	204	264	324	385	445	506	567	627	689	750	811	873	935	24
25	25	85	145	205	265	325	386	446	507	568	628	690	751	812	874	936	25
26	26	86	146	206	266	326	387	447	508	569	629	691	752	813	875	937	26
27	27	87	147	207	267	327	388	448	509	570	631	692	753	815	876	938	27
28	28	88	148	208	268	328	389	449	510	571	632	693	754	816	877	939	28
29	29	89	149	209	269	330	390	450	511	572	633	694	755	817	878	941	29
30	30	90	150	210	270	331	391	451	512	573	634	695	756	818	879	942	30
31	31	91	151	211	271	332	392	452	513	574	635	696	757	819	880	943	31
32	32	92	152	212	272	333	393	453	514	575	636	697	758	820	882	944	32
33	33	93	153	213	273	334	394	454	515	576	637	698	759	821	883	945	33
34	34	94	154	214	274	335	395	455	516	577	638	699	760	822	884	946	34
35	35	95	155	215	275	336	396	456	517	578	639	700	761	823	885	947	35
36	36	96	156	216	276	337	397	457	518	579	640	701	762	824	886	948	36
37	37	97	157	217	277	338	398	458	519	580	641	702	763	825	887	949	37
38	38	98	158	218	278	339	399	459	520	581	642	703	764	826	888	950	38
39	39	99	159	219	279	340	400	460	521	582	643	704	765	827	889	951	39
40	40	100	160	220	280	341	401	461	522	583	644	705	766	828	890	952	40
41	41	101	161	221	281	342	402	462	523	584	645	706	767	829	891	953	41
42	42	102	162	222	282	343	403	463	524	585	646	707	768	830	892	954	42
43	43	103	163	223	283	344	404	464	525	586	647	708	769	831	893	955	43
44	44	104	164	224	284	345	405	465	526	587	648	709	770	832	894	956	44
45	45	105	165	225	285	346	406	466	527	588	649	710	771	833	895	957	45
46	46	106	166	226	286	347	407	467	528	589	650	711	772	834	896	958	46
47	47	107	167	227	287	348	408	468	529	590	651	712	773	835	897	959	47
48	48	108	168	228	288	349	409	469	530	591	652	713	774	836	898	960	48
49	49	109	169	229	289	350	410	470	531	592	653	714	776	837	899	961	49
50	50	110	170	230	290	351	411	471	532	593	654	715	777	838	900	962	50
51	51	111	171	231	291	352	412	472	533	594	655	716	778	839	901	963	51
52	52	112	172	232	292	353	413	473	534	595	656	717	779	840	902	964	52
53	53	113	173	233	293	354	414	474	535	596	657	718	780	841	903	965	53
54	54	114	174	234	294	355	415	475	536	597	658	719	781	842	904	966	54
55	55	115	175	235	295	356	416	477	537	598	659	720	782	843	905	968	55
56	56	116	176	236	296	357	417	478	538	599	660	721	783	844	906	969	56
57	57	117	177	237	297	358	418	479	539	600	661	722	784	845	907	970	57
58	58	118	178	238	298	359	419	480	540	601	662	723	785	846	908	971	58
59	59	119	179	239	299	360	420	481	541	602	663	724	786	847	909	972	59
′	0°	1°	2°	3°	4°	5°	6°	7°	8°	9°	10°	11°	12°	13°	14°	15°	′

TABLE 6.

Meridional Parts.

′	16°	17°	18°	19°	20°	21°	22°	23°	24°	25°	26°	27°	28°	′
0	973	1035	1098	1161	1225	1289	1354	1419	1484	1550	1616	1684	1751	0
1	974	1036	1099	1163	1226	1290	1355	1420	1485	1551	1618	1685	1752	1
2	975	1037	1100	1164	1227	1291	1356	1421	1486	1552	1619	1686	1753	2
3	976	1038	1101	1165	1228	1292	1357	1422	1487	1553	1620	1687	1755	3
4	977	1039	1102	1166	1229	1293	1358	1423	1488	1554	1621	1688	1756	4
5	978	1041	1103	1167	1230	1295	1359	1424	1490	1556	1622	1689	1757	5
6	979	1042	1105	1168	1232	1296	1360	1425	1491	1557	1623	1690	1758	6
7	980	1043	1106	1169	1233	1297	1361	1426	1492	1558	1624	1691	1759	7
8	981	1044	1107	1170	1234	1298	1362	1427	1493	1559	1625	1693	1760	8
9	982	1045	1108	1171	1235	1299	1363	1428	1494	1560	1626	1694	1761	9
10	983	1046	1109	1172	1236	1300	1364	1430	1495	1561	1628	1695	1762	10
11	984	1047	1110	1173	1237	1301	1366	1431	1496	1562	1629	1696	1764	11
12	985	1048	1111	1174	1238	1302	1367	1432	1497	1563	1630	1697	1765	12
13	986	1049	1112	1175	1239	1303	1368	1433	1498	1564	1631	1698	1766	13
14	987	1050	1113	1176	1240	1304	1369	1434	1499	1565	1632	1699	1767	14
15	988	1051	1114	1177	1241	1305	1370	1435	1500	1567	1633	1700	1768	15
16	989	1052	1115	1178	1242	1306	1371	1436	1502	1568	1634	1701	1769	16
17	990	1053	1116	1179	1243	1307	1372	1437	1503	1569	1635	1703	1770	17
18	991	1054	1117	1181	1244	1308	1373	1438	1504	1570	1637	1704	1772	18
19	993	1055	1118	1182	1245	1310	1374	1439	1505	1571	1638	1705	1773	19
20	994	1056	1119	1183	1246	1311	1375	1440	1506	1572	1639	1706	1774	20
21	995	1057	1120	1184	1248	1312	1376	1441	1507	1573	1640	1707	1775	21
22	996	1058	1121	1185	1249	1313	1377	1443	1508	1574	1641	1708	1776	22
23	997	1069	1122	1186	1250	1314	1379	1444	1509	1575	1642	1709	1777	23
24	998	1060	1123	1187	1251	1315	1380	1445	1510	1577	1643	1711	1778	24
25	999	1061	1125	1188	1252	1316	1381	1446	1511	1578	1644	1712	1780	25
26	1000	1063	1126	1189	1253	1317	1382	1447	1513	1579	1645	1713	1781	26
27	1001	1064	1127	1190	1254	1318	1383	1448	1514	1580	1647	1714	1782	27
28	1002	1065	1128	1191	1255	1319	1384	1449	1515	1581	1648	1715	1783	28
29	1003	1066	1129	1192	1256	1320	1385	1450	1516	1582	1649	1716	1784	29
30	1004	1067	1130	1193	1257	1321	1386	1451	1517	1583	1650	1717	1785	30
31	1005	1068	1131	1194	1258	1322	1387	1452	1518	1584	1651	1718	1786	31
32	1006	1069	1132	1195	1259	1324	1388	1453	1519	1585	1652	1720	1787	32
33	1007	1070	1133	1196	1260	1325	1389	1455	1520	1586	1653	1721	1789	33
34	1008	1071	1134	1198	1261	1326	1390	1456	1521	1588	1654	1722	1790	34
35	1009	1072	1135	1199	1262	1327	1392	1457	1522	1589	1656	1723	1791	35
36	1010	1073	1136	1200	1264	1328	1393	1458	1524	1590	1657	1724	1792	36
37	1011	1074	1137	1201	1265	1329	1394	1459	1525	1591	1658	1725	1793	37
38	1012	1075	1138	1202	1266	1330	1395	1460	1526	1592	1659	1726	1794	38
39	1013	1076	1139	1203	1267	1331	1396	1461	1527	1593	1660	1727	1795	39
40	1014	1077	1140	1204	1268	1332	1397	1462	1528	1594	1661	1729	1797	40
41	1015	1078	1141	1205	1269	1333	1398	1463	1529	1595	1662	1730	1798	41
42	1016	1079	1142	1206	1270	1334	1399	1464	1530	1596	1663	1731	1799	42
43	1018	1080	1144	1207	1271	1335	1400	1465	1531	1598	1664	1732	1800	43
44	1019	1081	1145	1208	1272	1336	1401	1467	1532	1599	1666	1733	1801	44
45	1020	1082	1146	1209	1273	1338	1402	1468	1533	1600	1667	1734	1802	45
46	1021	1084	1147	1210	1274	1339	1403	1469	1535	1601	1668	1735	1803	46
47	1022	1085	1148	1211	1275	1340	1405	1470	1536	1602	1669	1736	1805	47
48	1023	1086	1149	1212	1276	1341	1406	1471	1537	1603	1670	1738	1806	48
49	1024	1087	1150	1213	1277	1342	1407	1472	1538	1604	1671	1739	1807	49
50	1025	1088	1151	1215	1278	1343	1408	1473	1539	1605	1672	1740	1808	50
51	1026	1089	1152	1216	1280	1344	1409	1474	1540	1606	1673	1741	1809	51
52	1027	1090	1153	1217	1281	1345	1410	1475	1541	1608	1675	1742	1810	52
53	1028	1091	1154	1218	1282	1346	1411	1476	1542	1609	1676	1743	1811	53
54	1029	1092	1155	1219	1283	1347	1412	1477	1543	1610	1677	1744	1813	54
55	1030	1093	1156	1220	1284	1348	1413	1479	1544	1611	1678	1746	1814	55
56	1031	1094	1157	1221	1285	1349	1414	1480	1546	1612	1679	1747	1815	56
57	1032	1095	1158	1222	1286	1350	1415	1481	1547	1613	1680	1748	1816	57
58	1033	1096	1159	1223	1287	1352	1416	1482	1548	1614	1681	1749	1817	58
59	1034	1097	1160	1224	1288	1353	1418	1483	1549	1615	1682	1750	1818	59
′	16°	17°	18°	19°	20°	21°	22°	23°	24°	25°	26°	27°	28°	

Meridional Parts.

′	29°	30°	31°	32°	33°	34°	35°	36°	37°	38°	39°	40°	41°	′
0	1819	1888	1958	2028	2100	2171	2244	2318	2393	2468	2545	2623	2702	0
1	1821	1890	1959	2030	2101	2173	2246	2319	2394	2470	2546	2624	2703	1
2	1822	1891	1960	2031	2102	2174	2247	2320	2395	2471	2548	2625	2704	2
3	1823	1892	1962	2032	2103	2175	2248	2322	2396	2472	2549	2627	2706	3
4	1824	1893	1963	2033	2104	2176	2249	2323	2398	2473	2550	2628	2707	4
5	1825	1894	1964	2034	2105	2178	2250	2324	2399	2475	2551	2629	2708	5
6	1826	1895	1965	2035	2107	2179	2252	2325	2400	2476	2553	2631	2710	6
7	1827	1896	1966	2037	2108	2180	2253	2327	2401	2477	2554	2632	2711	7
8	1829	1898	1967	2038	2109	2181	2254	2328	2408	2478	2555	2633	2712	8
9	1830	1899	1969	2039	2110	2182	2255	2329	2404	2480	2557	2634	2714	9
10	1831	1900	1970	2040	2111	2184	2257	2330	2405	2481	2558	2636	2715	10
11	1832	1901	1971	2041	2113	2185	2258	2332	2406	2482	2559	2637	2716	11
12	1833	1902	1972	2043	2114	2186	2259	2333	2408	2484	2560	2638	2718	12
13	1834	1903	1973	2044	2115	2187	2260	2334	2409	2485	2562	2640	2719	13
14	1835	1905	1974	2045	2116	2188	2261	2335	2410	2486	2563	2641	2720	14
15	1837	1906	1976	2046	2117	2190	2263	2337	2411	2487	2564	2642	2722	15
16	1838	1907	1977	2047	2119	2191	2264	2338	2413	2489	2566	2644	2723	16
17	1839	1908	1978	2048	2120	2192	2265	2339	2414	2490	2567	2645	2724	17
18	1840	1909	1979	2050	2121	2193	2266	2340	2415	2491	2568	2646	2726	18
19	1841	1910	1980	2051	2122	2194	2268	2342	2416	2492	2569	2648	2727	19
20	1842	1912	1981	2052	2123	2196	2269	2343	2418	2494	2571	2649	2728	20
21	1843	1913	1983	2053	2125	2197	2270	2344	2419	2495	2572	2650	2729	21
22	1845	1914	1984	2054	2126	2198	2271	2345	2420	2496	2573	2651	2731	22
23	1846	1915	1985	2056	2127	2199	2272	2346	2422	2498	2575	2653	2732	23
24	1847	1916	1986	2057	2128	2200	2274	2348	2423	2499	2576	2654	2733	24
25	1848	1917	1987	2058	2129	2202	2275	2349	2424	2500	2577	2655	2735	25
26	1849	1918	1988	2059	2131	2203	2276	2350	2425	2501	2578	2657	2736	26
27	1850	1920	1990	2060	2132	2204	2277	2351	2427	2503	2580	2658	2737	27
28	1852	1921	1991	2061	2133	2205	2279	2353	2428	2504	2581	2659	2739	28
29	1853	1922	1992	2063	2134	2207	2280	2354	2429	2505	2582	2661	2740	29
30	1854	1923	1993	2064	2135	2208	2281	2355	2430	2506	2584	2662	2742	30
31	1855	1924	1994	2065	2137	2209	2282	2356	2432	2508	2585	2663	2743	31
32	1856	1925	1995	2066	2138	2210	2283	2358	2433	2509	2586	2665	2744	32
33	1857	1927	1997	2067	2139	2211	2285	2359	2434	2510	2588	2666	2746	33
34	1858	1928	1998	2069	2140	2213	2286	2360	2435	2512	2589	2667	2747	34
35	1860	1929	1999	2070	2141	2214	2287	2361	2437	2513	2590	2669	2748	35
36	1861	1930	2000	2071	2143	2215	2288	2363	2438	2514	2591	2670	2750	36
37	1862	1931	2001	2072	2144	2216	2290	2364	2439	2515	2593	2671	2751	37
38	1863	1932	2002	2073	2145	2217	2291	2365	2440	2517	2594	2673	2752	38
39	1864	1934	2003	2075	2146	2219	2292	2366	2442	2518	2595	2674	2754	39
40	1865	1935	2005	2076	2147	2220	2293	2368	2443	2519	2597	2675	2755	40
41	1866	1936	2006	2077	2149	2221	2295	2369	2444	2521	2598	2676	2756	41
42	1868	1937	2007	2078	2150	2222	2296	2370	2445	2522	2599	2678	2758	42
43	1869	1938	2008	2079	2151	2224	2297	2371	2447	2523	2601	2679	2759	43
44	1870	1939	2010	2080	2152	2225	2298	2373	2448	2524	2602	2680	2760	44
45	1871	1941	2011	2082	2153	2226	2299	2374	2449	2526	2603	2682	2762	45
46	1872	1942	2012	2083	2155	2227	2301	2375	2451	2527	2604	2683	2763	46
47	1873	1943	2013	2084	2156	2228	2302	2376	2452	2528	2606	2684	2764	47
48	1875	1944	2014	2085	2157	2230	2303	2378	2453	2530	2607	2686	2766	48
49	1876	1945	2015	2086	2158	2231	2304	2379	2454	2531	2608	2687	2767	49
50	1877	1946	2017	2088	2159	2232	2306	2380	2456	2532	2610	2688	2768	50
51	1878	1948	2018	2089	2161	2233	2307	2381	2457	2533	2611	2690	2770	51
52	1879	1949	2019	2090	2162	2235	2308	2383	2458	2535	2612	2691	2771	52
53	1880	1950	2020	2091	2163	2236	2309	2384	2459	2536	2614	2692	2772	53
54	1881	1951	2021	2092	2164	2237	2311	2385	2461	2537	2615	2694	2774	54
55	1883	1952	2022	2094	2165	2238	2312	2386	2462	2538	2616	2695	2775	55
56	1884	1953	2024	2095	2167	2239	2313	2388	2463	2540	2617	2696	2776	56
57	1885	1955	2025	2096	2168	2241	2314	2389	2464	2541	2619	2698	2778	57
58	1886	1956	2026	2097	2169	2242	2316	2390	2466	2542	2620	2699	2779	58
59	1887	1957	2027	2098	2170	2243	2317	2391	2467	2544	2621	2700	2780	59
′	29°	30°	31°	32°	33°	34°	35°	36°	37°	38°	39°	40°	41°	′

TABLE 6.

Meridional Parts.

′	42°	43°	44°	45°	46°	47°	48°	49°	50°	51°	52°	53°	54°	′
0	2782	2863	2946	3030	3116	3203	3292	3382	3474	3569	3665	3764	3865	0
1	2783	2864	2947	3031	3117	3204	3293	3384	3476	3570	3667	3765	3866	1
2	2784	2866	2949	3033	3118	3206	3295	3385	3478	3572	3668	3767	3868	2
3	2786	2867	2950	3034	3120	3207	3296	3387	3479	3574	3670	3769	3870	3
4	2787	2869	2951	3036	3121	3209	3298	3388	3481	3575	3672	3770	3872	4
5	2788	2870	2953	3037	3123	3210	3299	3390	3482	3577	3673	3772	3873	5
6	2790	2871	2954	3038	3124	3212	3301	3391	3484	3578	3675	3774	3875	6
7	2791	2873	2956	3040	3126	3213	3302	3393	3485	3580	3677	3775	3877	7
8	2792	2874	2957	3041	3127	3214	3303	3394	3487	3582	3678	3777	3878	8
9	2794	2875	2958	3043	3129	3216	3305	3396	3488	3583	3680	3779	3880	9
10	2795	2877	2960	3044	3130	3217	3306	3397	3490	3585	3681	3780	3882	10
11	2797	2878	2961	3046	3131	3219	3308	3399	3492	3586	3683	3782	3883	11
12	2798	2880	2963	3047	3133	3220	3309	3400	3493	3588	3685	3784	3885	12
13	2799	2881	2964	3048	3134	3222	3311	3402	3495	3590	3686	3785	3887	13
14	2801	2882	2965	3050	3136	3223	3312	3403	3496	3591	3688	3787	3889	14
15	2802	2884	2967	3051	3137	3225	3314	3405	3498	3593	3690	3789	3890	15
16	2803	2885	2968	3053	3139	3226	3316	3407	3499	3594	3691	3790	3892	16
17	2805	2886	2970	3054	3140	3228	3317	3408	3501	3596	3693	3792	3894	17
18	2806	2888	2971	3055	3142	3229	3319	3410	3503	3598	3695	3794	3895	18
19	2807	2889	2972	3057	3143	3231	3320	3411	3504	3599	3696	3795	3897	19
20	2809	2891	2974	3058	3144	3232	3322	3413	3506	3601	3698	3797	3899	20
21	2810	2892	2975	3060	3146	3234	3323	3414	3507	3602	3699	3799	3901	21
22	2811	2893	2976	3061	3147	3235	3325	3416	3509	3604	3701	3800	3902	22
23	2813	2895	2978	3063	3149	3237	3326	3417	3510	3606	3703	3802	3904	23
24	2814	2896	2979	3064	3150	3238	3328	3419	3512	3607	3704	3804	3906	24
25	2815	2897	2981	3065	3152	3240	3329	3420	3514	3609	3706	3806	3907	25
26	2817	2899	2982	3067	3153	3241	3331	3422	3515	3610	3708	3807	3909	26
27	2818	2900	2983	3068	3155	3242	3332	3423	3517	3612	3709	3809	3911	27
28	[illegible]	2902	2985	3070	3156	3244	3334	3425	3518	3614	3711	3811	3913	28
29	[illegible]	[illegible]	2986	3071	3157	3245	3335	3427	3520	3615	3713	3812	3914	29
30	[illegible]	[illegible]	2988	3073	3159	3247	3337	3428	3521	3617	3714	3814	3916	30
31	[illegible]	[illegible]	2989	3074	3160	3248	3338	3430	3523	3618	3716	3816	3918	31
32	[illegible]	[illegible]	2991	3075	3162	3250	3340	3431	3525	3620	3717	3817	3919	32
33	[illegible]	[illegible]	2992	3077	3163	3251	3341	3433	3526	3622	3719	3819	3921	33
34	[illegible]	[illegible]	[illegible]	3078	3165	3253	3343	3434	3528	3623	3721	3821	3923	34
35	[illegible]	[illegible]	[illegible]	3080	3166	3254	3344	3436	3529	3625	3722	3822	3925	35
36	[illegible]	[illegible]	[illegible]	3081	3168	3256	3346	3437	3531	3626	3724	3824	3926	36
37	[illegible]	[illegible]	[illegible]	3083	3169	3257	3347	3439	3532	3628	3726	3826	3928	37
38	[illegible]	[illegible]	[illegible]	3084	3171	3259	3349	3440	3534	3630	3727	3827	3930	38
39	[illegible]	[illegible]	[illegible]	[illegible]	3172	3260	3350	3442	3536	3631	3729	3829	3932	39
40	[illegible]	[illegible]	[illegible]	[illegible]	3173	3262	3352	3443	3537	3633	3731	3831	3933	40
41	[illegible]	[illegible]	[illegible]	[illegible]	3175	3263	3353	3445	3539	3634	3732	3832	3935	41
42	[illegible]	[illegible]	[illegible]	[illegible]	3176	3265	3355	3447	3540	3636	3734	3834	3937	42
43	[illegible]	[illegible]	[illegible]	[illegible]	3178	3266	3356	3448	3542	3638	3736	3836	3938	43
44	[illegible]	[illegible]	[illegible]	[illegible]	3179	3268	3358	3450	3543	3639	3737	3838	3940	44
45	[illegible]	[illegible]	[illegible]	[illegible]	3181	3269	3359	3451	3545	3641	3739	3839	3942	45
46	[illegible]	[illegible]	[illegible]	[illegible]	3182	3271	3361	3453	3547	3643	3741	3841	3944	46
47	[illegible]	[illegible]	[illegible]	[illegible]	3184	3272	3362	3454	3548	3644	3742	3843	3945	47
48	[illegible]	[illegible]	[illegible]	[illegible]	3185	3274	3364	3456	3550	3646	3744	3844	3947	48
49	[illegible]	[illegible]	[illegible]	[illegible]	3187	3275	3365	3457	3551	3647	3746	3846	3949	49
50	[illegible]	[illegible]	[illegible]	[illegible]	3188	3277	3367	3459	3553	3649	3747	3848	3951	50
51	[illegible]	[illegible]	[illegible]	[illegible]	3190	3278	3368	3460	3555	3651	3749	3849	3952	51
52	[illegible]	[illegible]	[illegible]	[illegible]	3191	3280	3370	3462	3556	3652	3750	3851	3954	52
53	[illegible]	[illegible]	[illegible]	[illegible]	3193	3281	3371	3464	3558	3654	3752	3853	3956	53
54	[illegible]	[illegible]	[illegible]	[illegible]	3194	3283	3373	3465	3559	3655	3754	3854	3958	54
55	[illegible]	[illegible]	[illegible]	[illegible]	3196	3284	3374	3467	3561	3657	3755	3856	3959	55
56	[illegible]	[illegible]	[illegible]	[illegible]	3197	3286	3376	3468	3562	3659	3757	3858	3961	56
57	[illegible]	[illegible]	[illegible]	[illegible]	3199	3287	3378	3470	3564	3660	3759	3860	3963	57
58	[illegible]	[illegible]	[illegible]	[illegible]	3200	3289	3379	3471	3566	3662	3760	3861	3964	58
59	[illegible]	[illegible]	[illegible]	[illegible]	3201	3290	3381	3473	3567	3664	3762	3863	3966	59
′	42°	43°	44°	45°	46°	47°	48°	49°	50°	51°	52°	53°	54°	′

TABLE 6.

Meridional Parts.

′	55°	56°	57°	58°	59°	60°	61°	62°	63°	64°	65°	66°	67°	′
0	3968	4074	4183	4294	4409	4527	4649	4775	4905	5039	5179	5324	5474	0
1	3970	4076	4184	4296	4411	4529	4651	4777	4907	5042	5181	5326	5477	1
2	3971	4077	4186	4298	4413	4531	4653	4779	4909	5044	5184	5328	5479	2
3	3973	4079	4188	4300	4415	4533	4655	4781	4912	5046	5186	5331	5482	3
4	3975	4081	4190	4302	4417	4535	4657	4784	4914	5049	5188	5333	5484	4
5	3977	4083	4192	4304	4419	4537	4660	4786	4916	5051	5191	5336	5487	5
6	3978	4085	4194	4306	4421	4539	4662	4788	4918	5052	5193	5338	5489	6
7	3980	4086	4195	4308	4423	4541	4664	4790	4920	5055	5195	5341	5492	7
8	3982	4088	4197	4309	4425	4543	4666	4792	4923	5058	5198	5343	5495	8
9	3984	4090	4199	4311	4427	4545	4668	4794	4925	5060	5200	5346	5497	9
10	3985	4092	4201	4313	4429	4547	4670	4796	4927	5062	5203	5348	5500	10
11	3987	4094	4203	4315	4431	4549	4672	4798	4929	5065	5205	5351	5502	11
12	3989	4095	4205	4317	4433	4551	4674	4801	4931	5067	5207	5353	5505	12
13	3991	4097	4207	4319	4434	4553	4676	4803	4934	5069	5210	5356	5507	13
14	3992	4099	4208	4321	4436	4555	4678	4805	4936	5071	5212	5358	5510	14
15	3994	4101	4210	4323	4438	4557	4680	4807	4938	5074	5214	5361	5513	15
16	3996	4103	4212	4325	4440	4559	4682	4809	4940	5076	5217	5363	5515	16
17	3998	4104	4214	4327	4442	4562	4684	4811	4943	5078	5219	5366	5518	17
18	3999	4106	4216	4328	4444	4564	4687	4814	4945	5080	5222	5368	5520	18
19	4001	4108	4218	4330	4446	4566	4689	4816	4947	5082	5224	5371	5524	19
20	4003	4110	4220	4332	4448	4568	4691	4818	4949	5085	5226	5373	5526	20
21	4005	4112	4221	4334	4450	4570	4693	4820	4951	5088	5229	5376	5528	21
22	4006	4113	4223	4336	4452	4572	4695	4822	4954	5090	5231	5378	5531	22
23	4008	4115	4225	4338	4454	4574	4697	4824	4956	5092	5234	5380	5533	23
24	4010	4117	4227	4340	4456	4576	4699	4826	4958	5095	5236	5383	5536	24
25	4012	4119	4229	4342	4458	4578	4701	4829	4960	5097	5238	5385	5539	25
26	4014	4121	4231	4344	4460	4580	4703	4831	4963	5099	5241	5388	5541	26
27	4015	4122	4232	4346	4462	4582	4705	4833	4965	5102	5243	5390	5544	27
28	4017	4124	4234	4347	4464	4584	4707	4835	4967	5104	5246	5393	5546	28
29	4019	4126	4236	4349	4466	4586	4710	4837	4969	5106	5248	5395	5549	29
30	4021	4128	4238	4351	4468	4588	4712	4839	4972	5108	5250	5398	5552	30
31	4022	4130	4240	4353	4470	4590	4714	4842	4974	5111	5253	5401	5554	31
32	4024	4132	4242	4355	4472	4592	4716	4844	4976	5113	5255	5403	5557	32
33	4026	4133	4244	4357	4474	4594	4718	4846	4978	5115	5258	5406	5559	33
34	4028	4135	4246	4359	4476	4596	4720	4848	4981	5118	5260	5408	5562	34
35	4029	4137	4247	4361	4478	4598	4722	4850	4983	5120	5263	5411	5565	35
36	4031	4139	4249	4363	4480	4600	4724	4852	4985	5122	5265	5413	5567	36
37	4033	4141	4251	4365	4482	4602	4726	4855	4987	5125	5267	5416	5570	37
38	4035	4142	4253	4367	4484	4604	4728	4857	4990	5127	5270	5418	5573	38
39	4037	4144	4255	4369	4486	4606	4731	4859	4992	5129	5272	5421	5575	39
40	4038	4146	4257	4370	4488	4608	4733	4861	4994	5132	5275	5423	5578	40
41	4040	4148	4259	4372	4490	4610	4735	4863	4996	5134	5277	5426	5580	41
42	4042	4150	4260	4374	4492	4612	4737	4865	4999	5136	5280	5428	5583	42
43	4044	4152	4262	4376	4494	4614	4739	4868	5001	5139	5282	5431	5586	43
44	4045	4153	4264	4378	4495	4616	4741	4870	5003	5141	5284	5433	5588	44
45	4047	4155	4266	4380	4497	4618	4743	4872	5005	5143	5287	5436	5591	45
46	4049	4157	4268	4382	4499	4620	4745	4874	5008	5146	5289	5438	5594	46
47	4051	4159	4270	4384	4501	4623	4747	4876	5010	5148	5292	5441	5596	47
48	4052	4161	4272	4386	4503	4625	4750	4879	5012	5151	5294	5443	5599	48
49	4054	4162	4274	4388	4505	4627	4752	4881	5014	5153	5297	5446	5602	49
50	4056	4164	4275	4390	4507	4629	4754	4883	5017	5155	5299	5448	5604	50
51	4058	4166	4277	4392	4509	4631	4756	4885	5019	5158	5301	5451	5607	51
52	4060	4168	4279	4394	4511	4633	4758	4887	5021	5160	5304	5454	5610	52
53	4061	4170	4281	4396	4513	4635	4760	4890	5023	5162	5306	5456	5612	53
54	4063	4172	4283	4398	4515	4637	4762	4892	5026	5165	5309	5459	5615	54
55	4065	4173	4285	4399	4517	4639	4764	4894	5028	5167	5311	5461	5617	55
56	4067	4175	4287	4401	4519	4641	4766	4896	5030	5169	5314	5464	5620	56
57	4069	4177	4289	4403	4521	4643	4769	4898	5033	5172	5316	5466	5623	57
58	4070	4179	4291	4405	4523	4645	4771	4901	5035	5174	5319	5469	5625	58
59	4072	4181	4292	4407	4525	4647	4773	4903	5037	5176	5321	5471	5628	59
′	55°	56°	57°	58°	59°	60°	61°	62°	63°	64°	65°	66°	67°	′

TABLE 6.

Meridional Parts.

′	68°	69°	70°	71°	72°	73°	74°	75°	76°	77°	78°	79°	80°	′
0	5631	5795	5966	6146	6335	6534	6746	6970	7210	7467	7745	8046	8375	0
1	5633	5797	5969	6149	6338	6538	6749	6974	7214	7472	7749	8051	8381	1
2	5636	5800	5972	6152	6341	6541	6753	6978	7218	7476	7754	8056	8387	2
3	5639	5803	5975	6155	6345	6545	6757	6982	7222	7481	7759	8061	8393	3
4	5642	5806	5978	6158	6348	6548	6760	6986	7227	7485	7764	8067	8398	4
5	5644	5809	5981	6161	6351	6552	6764	6990	7231	7490	7769	8072	8404	5
6	5647	5811	5984	6164	6354	6555	6768	6994	7235	7494	7774	8077	8410	6
7	5650	5814	5986	6167	6358	6558	6771	6997	7239	7498	7778	8083	8416	7
8	5652	5817	5989	6170	6361	6562	6775	7001	7243	7503	7783	8088	8422	8
9	5655	5820	5992	6173	6364	6565	6779	7005	7247	7507	7788	8093	8427	9
10	5658	5823	5995	6177	6367	6569	6782	7009	7252	7512	7793	8099	8433	10
11	5660	5825	5998	6180	6371	6572	6786	7013	7256	7516	7798	8104	8439	11
12	5663	5828	6001	6183	6374	6576	6790	7017	7260	7521	7803	8109	8445	12
13	5666	5831	6004	6186	6377	6579	6793	7021	7264	7525	7808	8115	8451	13
14	5668	5834	6007	6189	6380	6583	6797	7025	7268	7530	7813	8120	8457	14
15	5671	5837	6010	6192	6384	6586	6801	7029	7273	7535	7817	8125	8463	15
16	5674	5839	6013	6195	6387	6590	6804	7033	7277	7539	7822	8131	8469	16
17	5676	5842	6016	6198	6390	6593	6808	7037	7281	7544	7827	8136	8474	17
18	5679	5845	6019	6201	6394	6597	6812	7041	7285	7548	7832	8141	8480	18
19	5682	5848	6022	6205	6397	6600	6815	7045	7289	7553	7837	8147	8486	19
20	5685	5851	6025	6208	6400	6603	6819	7048	7294	7557	7842	8152	8492	20
21	5687	5854	6028	6211	6403	6607	6823	7052	7298	7562	7847	8158	8498	21
22	5690	5856	6031	6214	6407	6610	6826	7056	7302	7566	7852	8163	8504	22
23	5693	5859	6034	6217	6410	6614	6830	7060	7306	7571	7857	8168	8510	23
24	5695	5862	6037	6220	6413	6617	6834	7064	7311	7576	7862	8174	8516	24
25	5698	5865	6040	6223	6417	6621	6838	7068	7315	7580	7867	8179	8522	25
26	5701	5868	6043	6226	6420	6624	6841	7072	7319	7585	7872	8185	8528	26
27	5704	5871	6046	6230	6423	6628	6845	7076	7323	7589	7877	8190	8534	27
28	5706	5874	6049	6233	6427	6631	6849	7080	7328	7594	7882	8196	8540	28
29	5709	5876	6052	6236	6430	6635	6853	7084	7332	7599	7887	8201	8546	29
30	5712	5879	6055	6239	6433	6639	6856	7088	7336	7603	7892	8207	8552	30
31	5715	5882	6058	6242	6437	6642	6860	7092	7341	7608	7897	8212	8558	31
32	5717	5885	6061	6245	6440	6646	6864	7096	7345	7612	7902	8218	8565	32
33	5720	5888	6064	6249	6443	6649	6868	7100	7349	7617	7907	8223	8571	33
34	5723	5891	6067	6252	6447	6653	6871	7104	7353	7622	7912	8229	8577	34
35	5725	5894	6070	6255	6450	6656	6875	7108	7358	7626	7917	8234	8583	35
36	5728	5896	6073	6258	6453	6660	6879	7112	7362	7631	7922	8240	8589	36
37	5731	5899	6076	6261	6457	6663	6883	7116	7366	7636	7927	8245	8595	37
38	5734	5902	6079	6264	6460	6667	6886	7120	7371	7640	7932	8251	8601	38
39	5736	5905	6082	6268	6463	6670	6890	7124	7375	7645	7937	8256	8607	39
40	5739	5908	6085	6271	6467	6674	6894	7128	7379	7650	7942	8262	8614	40
41	5742	5911	6088	6274	6470	6677	6898	7132	7384	7654	7948	8267	8620	41
42	5745	5914	6091	6277	6473	6681	6901	7136	7388	7659	7953	8273	8626	42
43	5747	5917	6094	6280	6477	6685	6905	7140	7392	7664	7958	8279	8632	43
44	5750	5919	6097	6283	6480	6688	6909	7145	7397	7668	7963	8284	8638	44
45	5753	5922	6100	6287	6483	6602	6913	7149	7401	7673	7968	8290	8644	45
46	5756	5925	6103	6290	6487	6695	6917	7153	7406	7678	7973	8295	8651	46
47	5758	5928	6106	6293	6490	6699	6920	7157	7410	7683	7978	8301	8657	47
48	5761	5931	6109	6296	6494	6702	6924	7161	7414	7687	7983	8307	8663	48
49	5764	5934	6112	6299	6497	6706	6928	7165	7419	7692	7989	8312	8669	49
50	5767	5937	6115	6303	6500	6710	6932	7169	7423	7697	7994	8318	8676	50
51	5770	5940	6118	6306	6504	6713	6936	7173	7427	7702	7999	8324	8682	51
52	5772	5943	6121	6309	6507	6717	6940	7177	7432	7706	8004	8329	8688	52
53	5775	5946	6124	6312	6511	6720	6943	7181	7436	7711	8009	8335	8695	53
54	5778	5948	6127	6315	6514	6724	6947	7185	7441	7716	8014	8341	8701	54
55	5781	5951	6130	6319	6517	6728	6951	7189	7445	7721	8020	8347	8707	55
56	5783	5954	6133	6322	6521	6731	6955	7194	7449	7725	8025	8352	8714	56
57	5786	5957	6136	6325	6524	6735	6959	7198	7454	7730	8030	8358	8720	57
58	5789	5960	6140	[illegible]	6528	6738	6963	7202	7458	7735	8035	8364	8726	58
59	5792	5963	6143	[illegible]	6531	6742	6966	7206	7463	7740	8040	8369	8733	59
′	68°	69°	70°	71°	72°	73°	74°	75°	76°	77°	78°	79°	80°	′

TABLE 7.

Mean Refraction.

App. Alt.	Refr.	App. Alt.	Refr.	App. Alt.	Refr.	App. Alt.	Refr.	App. Alt.	Refr.
° ′	′ ″	° ′	′ ″	° ′	′ ″	° ′	′ ″	° ′	′ ″
0 0	33 0	5 0	9 54	10 0	5 15	20 0	2 35	34 0	1 24
0 5	32 10	5 5	9 46	10 10	5 10	20 10	2 34	34 30	1 23
0 10	31 22	5 10	9 38	10 20	5 5	20 20	2 32	35 0	1 21
0 15	30 35	5 15	9 30	10 30	5 0	20 30	2 31	35 30	1 20
0 20	29 50	5 20	9 23	10 40	4 56	20 40	2 29	36 0	1 18
0 25	29 6	5 25	9 15	10 50	4 51	20 50	2 28	36 30	1 17
0 30	28 23	5 30	9 8	11 0	4 47	21 0	2 27	37 0	1 16
0 35	27 41	5 35	9 1	11 10	4 43	21 10	2 26	37 30	1 14
0 40	27 0	5 40	8 54	11 20	4 39	21 20	2 25	38 0	1 13
0 45	26 20	5 45	8 47	11 30	4 34	21 30	2 24	38 30	1 11
0 50	25 42	5 50	8 41	11 40	4 31	21 40	2 23	39 0	1 10
0 55	25 5	5 55	8 34	11 50	4 27	21 50	2 21	39 30	1 9
1 0	24 29	6 0	8 28	12 0	4 23	22 0	2 20	40 0	1 8
1 5	23 54	6 5	8 21	12 10	4 20	22 10	2 19	41 0	1 5
1 10	23 20	6 10	8 15	12 20	4 16	22 20	2 18	42 0	1 3
1 15	22 47	6 15	8 9	12 30	4 13	22 30	2 17	43 0	1 1
1 20	22 15	6 20	8 3	12 40	4 9	22 40	2 16	44 0	0 59
1 25	21 44	6 25	7 57	12 50	4 6	22 50	2 15	45 0	0 57
1 30	21 15	6 30	7 51	13 0	4 3	23 0	2 14	46 0	0 55
1 35	20 46	6 35	7 45	13 10	4 0	23 10	2 13	47 0	0 53
1 40	20 18	6 40	7 40	13 20	3 57	23 20	2 12	48 0	0 51
1 45	19 51	6 45	7 35	13 30	3 54	23 30	2 11	49 0	0 49
1 50	19 25	6 50	7 30	13 40	3 51	23 40	2 10	50 0	0 48
1 55	19 0	6 55	7 25	13 50	3 48	23 50	2 9	51 0	0 46
2 0	18 35	7 0	7 20	14 0	3 45	24 0	2 8	52 0	0 44
2 5	18 11	7 5	7 15	14 10	3 43	24 10	2 7	53 0	0 43
2 10	17 48	7 10	7 11	14 20	3 40	24 20	2 6	54 0	0 41
2 15	17 26	7 15	7 6	14 30	3 38	24 30	2 5	55 0	0 40
2 20	17 4	7 20	7 2	14 40	3 35	24 40	2 4	56 0	0 38
2 25	16 44	7 25	6 57	14 50	3 33	24 50	2 3	57 0	0 37
2 30	16 24	7 30	6 53	15 0	3 30	25 0	2 2	58 0	0 35
2 35	16 4	7 35	6 49	15 10	3 28	25 10	2 1	59 0	0 34
2 40	15 45	7 40	6 45	15 20	3 26	25 20	2 0	60 0	0 33
2 45	15 27	7 45	6 41	15 30	3 24	25 30	1 59	61 0	0 32
2 50	15 9	7 50	6 37	15 40	3 21	25 40	1 58	62 0	0 30
2 55	14 52	7 55	6 33	15 50	3 19	25 50	1 57	63 0	0 29
3 0	14 36	8 0	6 29	16 0	3 17	26 0	1 56	64 0	0 28
3 5	14 20	8 5	6 25	16 10	3 15	26 10	1 55	65 0	0 26
3 10	14 4	8 10	6 22	16 20	3 12	26 20	1 55	66 0	0 25
3 15	13 49	8 15	6 18	16 30	3 10	26 30	1 54	67 0	0 24
3 20	13 34	8 20	6 15	16 40	3 8	26 40	1 53	68 0	0 23
3 25	13 20	8 25	6 11	16 50	3 6	26 50	1 52	69 0	0 22
3 30	13 6	8 30	6 8	17 0	3 4	27 0	1 51	70 0	0 21
3 35	12 53	8 35	6 5	17 10	3 3	27 15	1 50	71 0	0 19
3 40	12 40	8 40	6 1	17 20	3 1	27 30	1 49	72 0	0 18
3 45	12 27	8 45	5 58	17 30	2 59	27 45	1 48	73 0	0 17
3 50	12 15	8 50	5 55	17 40	2 57	28 0	1 47	74 0	0 16
3 55	12 3	8 55	5 52	17 50	2 55	28 15	1 46	75 0	0 15
4 0	11 51	9 0	5 48	18 0	2 54	28 30	1 45	76 0	0 14
4 5	11 40	9 5	5 45	18 10	2 52	28 45	1 44	77 0	0 13
4 10	11 29	9 10	5 42	18 20	2 51	29 0	1 42	78 0	0 12
4 15	11 18	9 15	5 39	18 30	2 49	29 30	1 40	79 0	0 11
4 20	11 8	9 20	5 36	18 40	2 47	30 0	1 38	80 0	0 10
4 25	10 58	9 25	5 34	18 50	2 46	30 30	1 37	81 0	0 9
4 30	10 48	9 30	5 31	19 0	2 44	31 0	1 35	82 0	0 8
4 35	10 39	9 35	5 28	19 10	2 43	31 30	1 33	83 0	0 7
4 40	10 29	9 40	5 25	19 20	2 41	32 0	1 31	84 0	0 6
4 45	10 20	9 45	5 23	19 30	2 40	32 30	1 30	86 0	0 4
4 50	10 11	9 50	5 20	19 40	2 38	33 0	1 28	88 0	0 2
4 55	10 2	9 55	5 18	19 50	2 37	33 30	1 26	90 0	0 0

TABLE 8

Dip of the Horizon.

Height.	Dip.
Feet	′ ″
1	0 58
2	1 21
3	1 40
4	1 56
5	2 9
6	2 21
7	2 33
8	2 44
9	2 53
10	3 2
11	3 10
12	3 19
13	3 27
14	3 36
15	3 42
16	3 50
17	3 57
18	4 4
19	4 11
20	4 17
21	4 23
22	4 30
23	4 36
24	4 42
26	4 52
28	5 5
30	5 15
35	5 39
40	6 4
45	6 27
50	6 46
60	7 25
70	8 1
80	8 34
90	9 6
100	9 35

TABLE 10

Sun's Parallax in Alt.

Altit.	Parall.
°	″
0	9
10	9
20	8
30	8
40	7
50	6
55	5
60	4
65	4
70	3
75	2
80	2
85	1
90	0

TABLE 9.

Dip at different Distances from the Observer.

Miles.	Height of the Eye in Feet.					
	5	10	15	20	25	30
¼	11′	23′	34′	45′	57′	68′
½	6	12	17	23	28	34
¾	4	8	12	15	19	23
1	3	6	9	12	15	17
1¼	3	5	7	10	12	14
1½	3	4	6	8	10	12
2	2	4	5	7	8	9
2½	2	3	4	6	7	8
3	2	3	4	5	6	7
3½	2	3	4	5	6	6
4	2	3	4	5	5	6
5	2	3	4	4	5	6
6	2	3	4	4	5	5

TABLE 11.

To correct the Mean Refraction.

App. Alt.	Height of the Thermometer.								
	20°	28°	36°	44°	50°	56°	64°	72°	80°
° ′	add ″	add ″	add ″	add ″	″	sub ″	sub ″	sub ″	sub ″
3 0	71	51	32	13	0	13	30	46	61
3 30	64	46	29	12	0	12	27	41	55
4 0	58	41	26	11	0	10	24	37	50
4 30	53	38	24	10	0	9	22	34	45
5 0	48	35	22	9	0	9	20	31	40
5 30	45	32	20	9	0	8	19	29	38
6 0	41	30	19	8	0	7	17	26	35
6 30	38	28	17	7	0	7	15	24	33
7 0	36	26	16	7	0	6	14	23	31
7 30	34	25	16	7	0	6	14	22	29
8 0	32	23	15	6	0	5	13	20	27
8 30	30	22	14	6	0	5	12	19	26
9 0	28	20	13	5	0	5	11	18	24
10 0	26	18	12	5	0	4	10	16	22
11 0	23	17	11	5	0	4	9	15	20
12 0	21	15	10	4	0	4	9	13	18
			30·7	30·1	29·6	29·2	28·6		

Height of the Barometer.

App. Alt.	Height of the Thermometer.								
	20°	28°	36°	44°	50°	56°	64°	72°	80°
°	add ″	add ″	add ″	add ″	″	sub ″	sub ″	sub ″	sub ″
14	18	13	8	4	0	3	7	11	16
16	16	12	7	3	0	3	6	10	14
18	14	10	6	3	0	2	6	9	12
20	13	9	6	2	0	2	5	8	11
22	11	8	5	2	0	2	5	7	10
24	10	7	5	2	0	2	4	6	9
26	9	7	4	2	0	2	4	6	8
28	9	6	4	2	0	1	3	5	7
30	8	6	4	2	0	1	3	5	7
35	7	5	3	1	0	1	3	4	6
40	6	4	3	1	0	1	2	3	5
50	4	3	2	1	0	1	2	2	3
60	3	2	1	1	0	0	1	2	2
70	2	1	1	0	0	0	1	1	1
80	1	1	0	0	0	0	0	1	1
90	0	0	0	0	0	0	0	0	0
			30·7	30·1	29·6	29·2	28·6		

Height of the Barometer.

TABLE 15.

For reducing Longitude into Time, and the contrary.

°	h. m.	°	h. m.	°	h. m.	°	h. m.	°	h. m.	°	h. m.
′	m. s.	′	m. s.	′	m. s.	′	m. s.	′	m. s.	′	m. s.
″	s. t.	″	s. t.	″	s. t.	″	s. t.	″	s. t.	″	s. t.
1	0 4	31	2 4	61	4 4	91	6 4	121	8 4	151	10 4
2	0 8	32	2 8	62	4 8	92	6 8	122	8 8	152	10 8
3	0 12	33	2 12	63	4 12	93	6 12	123	8 12	153	10 12
4	0 16	34	2 16	64	4 16	94	6 16	124	8 16	154	10 16
5	0 20	35	2 20	65	4 20	95	6 20	125	8 20	155	10 20
6	0 24	36	2 24	66	4 24	96	6 24	126	8 24	156	10 24
7	0 28	37	2 28	67	4 28	97	6 28	127	8 28	157	10 28
8	0 32	38	2 32	68	4 32	98	6 32	128	8 32	158	10 32
9	0 36	39	2 36	69	4 36	99	6 36	129	8 36	159	10 36
10	0 40	40	2 40	70	4 40	100	6 40	130	8 40	160	10 40
11	0 44	41	2 44	71	4 44	101	6 44	131	8 44	161	10 44
12	0 48	42	2 48	72	4 48	102	6 48	132	8 48	162	10 48
13	0 52	43	2 52	73	4 52	103	6 52	133	8 52	163	10 52
14	0 56	44	2 56	74	4 56	104	6 56	134	8 56	164	10 56
15	1 0	45	3 0	75	5 0	105	7 0	135	9 0	165	11 0
16	1 4	46	3 4	76	5 4	106	7 4	136	9 4	166	11 4
17	1 8	47	3 8	77	5 8	107	7 8	137	9 8	167	11 8
18	1 12	48	3 12	78	5 12	108	7 12	138	9 12	168	11 12
19	1 16	49	3 16	79	5 16	109	7 16	139	9 16	169	11 16
20	1 20	50	3 20	80	5 20	110	7 20	140	9 20	170	11 20
21	1 24	51	3 24	81	5 24	111	7 24	141	9 24	171	11 24
22	1 28	52	3 28	82	5 28	112	7 28	142	9 28	172	11 28
23	1 32	53	3 32	83	5 32	113	7 32	143	9 32	173	11 32
24	1 36	54	3 36	84	5 36	114	7 36	144	9 36	174	11 36
25	1 40	55	3 40	85	5 40	115	7 40	145	9 40	175	11 40
26	1 44	56	3 44	86	5 44	116	7 44	146	9 44	176	11 44
27	1 48	57	3 48	87	5 48	117	7 48	147	9 48	177	11 48
28	1 52	58	3 52	88	5 52	118	7 52	148	9 52	178	11 52
29	1 56	59	3 56	89	5 56	119	7 56	149	9 56	179	11 56
30	2 0	60	4 0	90	6 0	120	8 0	150	10 0	180	12 0

TABLE 12.

The Right Ascensions and Declinations of the Principal Fixed Stars, adapted to January 1, 1846.

Charac	Constellations.	Pr. Names.	Magnitudes.	Right Ascension, in Time.			Ann.Var.	Declination.			Ann. Var.
				h.	m.	s.	s.	°	′	″	″
α	Andromeda	*Alpheratz*	1	0	0	26	+ 3·07	28	14	25 N	+ 20·06
γ	Pegasus	*Algenib*	2·3	0	5	0	+ 3·08	14	19	38 N	+ 20·05
α	Cassiopeia	*Schedar*	3	0	31	48	+ 3·34	55	41	31 N	+ 19·87
β	Andromeda	*Mirach*	2	1	1	7	+ 3·31	34	48	12 N	+ 19·36
α	Ursa Minor	*Pole Star*	2·3	1	3	52	+ 16·50	88	29	18 N	+ 19·32
α	Eridanus	*Achernar*	1	1	31	58	+ 2·23	58	1	14 S	— 18·47
α	Aries	ARIETIS	3	1	58	31	+ 3·35	22	43	59 N	+ 17·45
α	Cetus	*Menkar*	2·3	2	54	14	+ 3·13	3	28	56 N	+ 14·55
β	Perseus	*Algol*	Var.	2	58	10	+ 3·85	40	21	30 N	+ 14·35
α	Perseus		2·3	3	13	21	+ 4·23	49	18	28 N	+ 13·36
α	Taurus	ALDEBARAN	1	4	27	5	+ 3·43	16	11	41 N	+ 7·94
α	Auriga	*Capella*	1	5	5	19	+ 4·41	45	50	7 N	+ 4·77
β	Orion	*Rigel*	1	5	7	8	+ 2·88	8	23	3 S	— 4·61
β	Taurus		2	5	16	34	+ 3·78	28	28	17 N	+ 3·81
γ	Orion	*Bellatrix*	2	5	16	52	+ 3·21	6	12	21 N	+ 3·82
δ	Orion		2	5	24	8	+ 3·06	0	25	5 S	— 3·15
ε	Orion		2·3	5	28	24	+ 3·04	1	18	18 S	— 2·78
α	Columba		2	5	34	5	+ 2·17	34	9	37 S	— 1·28
α	Orion	*Betelguese*	1	5	46	50	+ 3·24	7	22	22 N	+ 1·18
α	Argo	*Canopus*	1	6	20	32	+ 1·33	52	36	49 S	+ 1·78
α	Canis Major	*Sirius*	1	6	38	22	+ 2·65	16	30	33 S	+ 4·46
α	Gemini	*Castor*	3	7	24	46	+ 3·86	32	13	13 N	— 7·22
α	Canis Minor	*Procyon*	1 2	7	31	41	+ 3·14	5	36	55 N	— 8·73
β	Gemini	POLLUX	2	7	35	53	+ 3·68	28	23	34 N	— 8·12
ε	Argo Navis		2	8	19	21	+ 1·24	59	1	2 S	+ 11·4
η	Argo Navis		2	10	39	6	+ 2·36	58	52	34 S	+ 18·8
ι	Argo Navis		2	9	12	58	+ 1·66	58	37	50 S	+ 15·00
α	Hydra	*Alphard*	2	9	20	1	+ 2·95	7	59	39 S	+ 15·35
α	Leo	REGULUS	1	10	0	10	+ 3·22	12	43	3 N	— 17·36
β	Ursa Major	*Mirak*	2	10	52	30	+ 3·68	57	12	23 N	— 19·16
α	Ursa Major	*Dubhe*	1·2	10	54	11	+ 3·81	62	34	52 N	— 19·23
β	Leo	*Denebola*	2·3	11	41	12	+ 3·07	15	25	58 N	— 19·99
γ	Ursa Major		2	11	45	42	+ 3·19	54	33	3 N	— 20·02
α	Crux		1.	12	18	5	+ 3·27	62	14	40 S	+ 20·00
α	Virgo	SPICA	1	13	17	5	+ 3·15	10	21	21 S	+ 18·94
η	Ursa Major	*Benetnach*	2·3	13	41	28	+ 2·35	50	5	1 N	— 18·13
β	Centaur		1	13	53	1	+ 4 15	59	37	34 S	+ 17·68
α	Draco		3	14	0	14	+ 1·62	65	6	47 N	— 17·38
α	Boötes	*Arcturus*	1	14	8	38	+ 2·73	19	59	12 N	— 18·95
β	Boötes	*Nekkar*	3	14	56	8	+ 2·33	41	0	4 N	— 14·15
α	Centaur		1	14	29	12	+ 4·01	60	11	37 S	+ 15·14
α	2 Libra	*Zubenesch*	3	14	42	22	+ 3·31	15	23	54 S	+ 15·25
β	Libra	*Zubenelg*	2·3	15	8	44	+ 3 22	8	48	39 S	+ 13·65
α	Corona Borealis	*Alphacca*	2	15	28	10	+ 2·53	27	14	11 N	— 12·35
α	Serpens		2·3	15	36	41	+ 2·94	6	54	50 N	— 11·76
α	Scorpio	ANTARES	1	16	19	58	+ 3·66	26	5	5 S	+ 8·51
α	Hercules	*Ras Algethi*	3·4	17	7	38	+ 2·73	14	34	13 N	— 4·57
α	Ophiuchus	*Ras Alhague*	2	17	27	47	+ 2·77	12	40	37 N	— 2·83
γ	Draco	*Rastaben*	2	17	53	2	+ 1·39	51	30	34 N	— 0·62
α	Lyra	*Vega*	1	18	31	43	+ 2·01	38	38	35 N	+ 2·75
α	AQUILÆ	ALTAIR	1·2	19	43	16	+ 2·93	8	27	54 N	+ 8·71
α	Pavo		2	20	13	26	+ 4·81	57	13	20 S	11·00
α	Cygnus	*Deneb*	1	20	36	11	+ 2·04	44	43	57 N	+ 12·62
α	Cepheus	*Alderaimin*	3	21	14	54	+ 1·42	61	56	5 N	+ 15·07
α	Aquarius		3	21	57	52	+ 3·08	1	3	57 S	— 17·26
α	Grux		2	21	58	30	+ 3·82	47	42	12 S	— 17·29
α	Pisces Australis	FOMALHAUT	1	22	49	8	+ 3·31	30	26	12 S	— 19·10
β	Pegasus	*Scheat*	2	22	56	19	+ 2·88	27	14	53 N	+ 19·26
α	PEGASUS	MARCAB	2	22	57	6	+ 2·98	14	22	40 N	+ 19·30

Corrections for the Sun's Apparent Altitude.

App. Alt.	Corr.	App. Alt.	Corr.	App. Alt.	Corr.	App. Alt.	Corr.	App. Alt.	Corr.	App. Alt.	Corr.
° ′	′ ″	° ′	′ ″	° ′	′ ″	° ′	′ ″	° ′	′ ″	° ′	′ ″
0 30	28 13	5 0	9 44	7 45	6 33	13 30	3 45	24 0	1 59	43 0	0 55
35	27 31	2	9 41	50	6 29	40	3 43	20	1 57	30	0 54
40	26 51	4	9 37	55	6 25	50	3 40	40	1 56	44 0	0 53
45	26 11	6	9 34	8 0	6 21	14 0	3 37	25 0	1 54	30	0 52
50	25 33	8	9 31	5	6 17	10	3 34	20	1 52	45 0	0 51
55	24 55	10	9 28	10	6 13	20	3 32	40	1 50	30	0 50
1 0	24 19	5 12	9 25	8 15	6 10	14 30	3 29	26 0	1 49	46 0	0 49
5	23 44	14	9 21	20	6 6	40	3 27	20	1 47	30	0 48
10	23 10	16	9 18	25	6 3	50	3 24	40	1 45	47 0	0 47
15	22 38	18	9 15	30	5 59	15 0	3 22	27 0	1 44	30	0 46
20	22 6	20	9 12	35	5 56	10	3 19	20	1 42	48 0	0 45
25	21 35	22	9 9	40	5 53	20	3 17	40	1 41	30	0 44
1 30	21 5	5 24	9 6	8 45	5 49	15 30	3 15	28 0	1 39	49 0	0 44
35	20 36	26	9 3	50	5 46	40	3 13	20	1 38	30	0 43
40	20 8	28	9 0	55	5 43	50	3 10	40	1 36	50 0	0 42
45	19 41	30	8 58	9 0	5 40	16 0	3 8	29 0	1 35	30	0 41
50	19 15	32	8 55	5	5 36	10	3 6	20	1 33	51 0	0 41
55	18 50	34	8 52	10	5 34	20	3 4	40	1 32	30	0 40
2 0	18 25	5 36	8 49	9 15	5 31	16 30	3 2	30 0	1 31	52 0	0 39
5	18 2	38	8 46	20	5 28	40	3 0	20	1 30	30	0 38
10	17 39	40	8 44	25	5 25	50	2 58	40	1 28	53 0	0 38
15	17 17	42	8 41	30	5 22	17 0	2 56	31 0	1 27	30	0 37
20	16 55	44	8 38	35	5 19	10	2 54	20	1 26	54 0	0 36
25	16 34	46	8 36	40	5 17	20	2 53	40	1 25	30	0 36
2 30	16 14	5 48	8 33	9 45	5 14	17 30	2 51	32 0	1 24	55 0	0 35
35	15 55	50	8 30	50	5 11	40	2 49	20	1 22	56 0	0 34
40	15 36	52	8 28	55	5 8	50	2 47	40	1 21	57 0	0 32
45	15 17	54	8 25	10 0	5 6	18 0	2 46	33 0	1 20	58 0	0 31
50	15 0	56	8 23	5	5 4	10	2 44	20	1 19	59 0	0 30
55	14 43	58	8 20	10	5 1	20	2 42	40	1 18	60 0	0 29
3 0	14 26	6 0	8 18	10 15	4 59	18 30	2 41	34 0	1 17	61 0	0 27
5	14 10	4	8 13	20	4 56	40	2 39	20	1 16	62 0	0 26
10	13 54	8	8 8	25	4 54	50	2 38	40	1 15	63 0	0 25
15	13 39	12	8 3	30	4 52	19 0	2 36	35 0	1 14	64 0	0 24
20	13 24	16	7 59	35	4 50	10	2 35	20	1 13	65 0	0 23
25	13 10	20	7 54	40	4 47	20	2 33	40	1 12	66 0	0 22
3 30	12 56	6 24	7 49	10 45	4 45	19 30	2 32	36 0	1 11	67 0	0 21
35	12 43	28	7 45	50	4 43	40	2 30	20	1 10	68 0	0 20
40	12 30	32	7 41	55	4 41	50	2 29	40	1 9	69 0	0 19
45	12 17	36	7 36	11 0	4 38	20 0	2 27	37 0	1 9	70 0	0 18
50	12 5	40	7 32	10	4 34	10	2 26	20	1 8	71 0	0 17
55	11 53	44	7 28	20	4 30	20	2 25	40	1 7	72 0	0 16
4 0	11 41	6 48	7 24	11 30	4 26	20 30	2 23	38 0	1 6	73 0	0 15
5	11 30	52	7 20	40	4 22	40	2 22	20	1 5	74 0	0 14
10	11 19	56	7 16	50	4 18	50	2 21	40	1 4	75 0	0 13
15	11 8	7 0	7 12	12 0	4 15	21 0	2 19	39 0	1 3	76 0	0 12
20	10 58	5	7 7	10	4 11	20	2 17	20	1 3	77 0	0 11
25	10 48	10	7 3	20	4 8	40	2 14	40	1 2	78 0	0 10
4 30	10 38	7 15	6 58	12 30	4 4	22 0	2 12	40 0	1 1	79 0	0 9
35	10 28	20	6 54	40	4 1	20	2 10	30	1 0	80 0	0 8
40	10 19	25	6 49	50	3 58	40	2 8	41 0	0 59	81 0	0 8
45	10 10	30	6 45	13 0	3 54	23 0	2 6	30	0 58	82 0	0 7
50	10 1	35	6 41	10	3 51	20	2 3	42 0	0 57	83 0	0 6
55	9 53	40	6 37	20	3 48	40	2 1	30	0 56	84 0	0 5
										85 0	0 4
										86 0	0 3
										87 0	0 3
										88 0	0 2
										89 0	0 1

TABLE 14.

Correction for the Observed Altitude of the Sun's Lower Limb.

Obs. Alt.	Height of Eye above the Sea in Feet.													
	6	8	10	12	14	16	18	20	22	24	26	28	30	32
° ′	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ′	′ ″	′ ″	′ ″	′ ″
5 0	3 48	3 30	3 6	2 48	2 30	2 18	2 6	1 48	1 36	1 24	1 12	1 0	0 48	0 36
5 20	4 18	4 0	3 36	3 18	3 6	2 48	2 36	2 18	2 6	1 54	1 42	1 30	1 18	1 6
5 40	4 48	4 30	4 6	3 48	3 30	3 18	3 6	2 48	2 36	2 24	2 12	2 0	1 48	1 36
6 0	5 18	4 54	4 36	4 18	4 0	3 42	3 30	3 18	3 0	2 48	2 36	2 24	2 12	2 6
6 20	5 42	5 24	5 0	4 42	4 24	4 6	3 54	3 42	3 18	3 12	3 0	2 48	2 36	2 30
6 40	6 0	5 42	5 18	5 0	4 42	4 30	4 18	4 0	3 48	3 36	3 24	3 12	3 0	2 48
7 0	6 24	6 0	5 42	5 24	5 6	4 48	4 36	4 24	4 6	3 54	3 42	3 30	3 18	3 12
7 20	6 42	6 18	6 0	5 42	5 24	5 6	4 54	4 42	4 24	4 12	4 0	3 48	3 36	3 30
7 40	6 54	6 36	6 12	5 54	5 42	5 24	5 12	4 54	4 42	4 30	4 18	4 6	3 54	3 48
8 0	7 12	6 48	6 30	6 12	5 54	5 42	5 24	5 18	5 0	4 48	4 36	4 24	4 12	4 0
8 20	7 30	7 6	6 42	6 30	6 12	5 54	5 42	5 30	5 12	5 0	4 48	4 36	4 24	4 18
8 40	7 42	7 18	7 0	6 42	6 24	6 6	5 54	5 42	5 30	5 12	5 0	4 48	4 42	4 30
9 0	7 54	7 30	7 12	6 54	6 36	6 24	6 6	5 54	5 42	5 30	5 18	5 6	4 54	4 42
9 20	8 6	7 42	7 24	7 6	6 48	6 36	6 18	6 6	5 54	5 42	5 30	5 18	5 6	4 54
9 40	8 18	7 54	7 36	7 18	7 0	6 42	6 30	6 18	6 6	5 48	5 36	5 24	5 18	5 6
10 0	8 30	8 6	7 48	7 30	7 12	6 54	6 42	6 30	6 12	6 0	5 48	5 36	5 24	5 18
10 30	8 42	8 18	8 0	7 42	7 24	7 12	6 54	6 42	6 30	6 18	6 6	5 54	5 42	5 30
11 0	8 54	8 36	8 12	7 54	7 36	7 24	7 12	6 54	6 42	6 30	6 18	6 6	5 54	5 42
11 30	9 6	8 48	8 24	8 6	7 48	7 36	7 24	7 6	6 54	6 42	6 30	6 18	6 6	5 54
12 0	9 18	9 0	8 42	8 18	8 0	7 48	7 36	7 18	7 6	6 54	6 42	6 30	6 18	6 12
13 0	9 36	9 18	9 0	8 42	8 24	8 6	7 54	7 42	7 24	7 12	7 0	6 48	6 36	6 30
14 0	9 54	9 36	9 12	8 54	8 42	8 24	8 12	7 54	7 42	7 30	7 18	7 6	6 54	6 48
15 0	10 12	9 48	9 30	9 12	8 54	8 42	8 24	8 12	8 0	7 48	7 36	7 24	7 12	7 0
16 0	10 24	10 6	9 42	9 24	9 6	8 54	8 42	8 24	8 12	8 0	7 48	7 36	7 24	7 12
17 0	10 36	10 18	9 54	9 36	9 18	9 6	8 54	8 36	8 18	8 12	8 0	7 48	7 36	7 24
18 0	10 48	10 24	10 6	9 48	9 30	9 18	9 0	8 48	8 36	8 24	8 12	8 0	7 48	7 36
19 0	11 0	10 36	10 18	10 0	9 42	9 24	9 12	9 0	8 48	8 30	8 18	8 6	8 0	7 48
20 0	11 6	10 42	10 24	10 6	9 48	9 36	9 18	9 6	8 54	8 42	8 30	8 12	8 6	7 54
21 0	11 12	10 54	10 30	10 12	10 0	9 42	9 30	9 12	9 0	8 48	8 36	8 24	8 12	8 6
22 0	11 24	11 0	10 42	10 24	10 6	9 48	9 36	9 24	9 6	8 54	8 42	8 30	8 18	8 12
23 0	11 30	11 6	10 48	10 30	10 12	9 54	9 42	9 30	9 12	9 0	8 48	8 36	8 24	8 18
24 0	11 36	11 12	10 54	10 36	10 18	10 0	9 48	9 36	9 18	9 6	8 54	8 42	8 30	8 24
25 0	11 42	11 18	11 0	10 42	10 24	10 6	9 54	9 42	9 24	9 12	9 0	8 48	8 36	8 30
26 0	11 42	11 24	11 0	10 42	10 30	10 12	10 0	9 42	9 30	9 18	9 6	8 54	8 42	8 36
27 0	11 48	11 30	11 6	10 48	10 30	10 18	10 6	9 48	9 36	9 24	9 12	9 0	8 48	8 36
28 0	11 54	11 36	11 12	10 54	10 36	10 24	10 12	9 54	9 42	9 30	9 18	9 6	8 54	8 42
30 0	12 0	11 42	11 18	11 0	10 48	10 30	10 18	10 0	9 48	9 36	9 24	9 12	9 0	8 54
32 0	12 12	11 48	11 30	11 12	10 54	10 36	10 24	10 12	9 54	9 42	9 30	9 18	9 6	9 0
34 0	12 18	11 54	11 36	11 18	11 0	10 42	10 30	10 18	10 6	9 54	9 36	9 24	9 12	9 6
36 0	12 24	12 0	11 42	11 24	11 6	10 48	10 36	10 24	10 12	9 54	9 42	9 30	9 18	9 12
38 0	12 30	12 6	11 48	11 30	11 12	10 54	10 42	10 30	10 12	10 0	9 48	9 36	9 24	9 18
40 0	12 30	12 12	11 48	11 30	11 18	11 0	10 48	10 30	10 18	10 6	9 54	9 42	9 30	9 24
42 0	12 36	12 12	11 54	11 36	11 18	11 6	10 48	10 36	10 24	10 12	10 0	9 48	9 36	9 24
44 0	12 42	12 18	12 0	11 42	11 24	11 6	10 54	10 42	10 30	10 12	10 6	9 48	9 42	9 30
46 0	12 42	12 24	12 0	11 42	11 30	11 12	11 0	10 42	10 30	10 18	10 12	9 54	9 42	9 36
48 0	12 48	12 24	12 6	11 48	11 30	11 18	11 0	10 48	10 36	10 24	10 12	10 0	9 48	9 36
50 0	12 48	12 30	12 12	11 54	11 36	11 18	11 6	10 54	10 36	10 24	10 18	10 0	9 48	9 42
52 0	12 54	12 30	12 12	11 54	11 36	11 24	11 6	10 54	10 42	10 30	10 18	10 6	9 54	9 42
54 0	13 0	12 36	12 18	12 0	11 42	11 24	11 12	11 0	10 42	10 30	10 18	10 6	9 54	9 48
58 0	13 0	12 42	12 18	12 0	11 42	11 30	11 18	11 0	10 48	10 36	10 24	10 12	10 0	9 54
62 0	13 6	12 48	12 24	12 6	11 48	11 36	11 24	11 6	10 54	10 42	10 30	10 18	10 6	9 54
66 0	13 12	12 48	12 30	12 12	11 54	11 42	11 24	11 12	11 0	10 48	10 36	10 24	10 12	10 0
70 0	13 18	12 54	12 36	12 18	12 0	11 48	11 30	11 18	11 0	10 48	10 36	10 24	10 12	10 6
80 0	13 24	13 6	12 42	12 24	12 6	11 54	11 42	11 24	11 12	11 0	10 48	10 36	10 24	10 12
90 0	13 36	13 12	12 54	12 36	12 18	12 0	11 48	11 36	11 18	11 6	10 54	10 42	10 30	10 24
Month	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.		
Corr.	+ 18′	+ 12″	+ 6″	—0″	—12″	—12″	—18″	—12″	—6″	+ 6″	+ 12″	+ 18″		

[For TABLE 15, *see* p. 134 *ante.*]

TABLE 16.

Sun's Declination for the Years 1844, 1848, 1852, 1856, &c.

Days	Jan. South.	Feb. South.	March. South.	April. North	May. North	June. North.	July. North.	Aug. North.	Sept. North.	Oct. South	Nov. South.	Dec. South	Days
	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	
1	23 4	17 16	7 25	4 42	15 12	22 7	23 6	17 57	8 10	3 20	14 34	21 53	1
2	22 59	16 59	7 2	5 5	15 30	22 15	23 2	17 42	7 48	3 43	14 53	22 2	2
3	22 53	16 41	6 40	5 28	15 47	22 22	22 57	17 26	7 26	4 6	15 12	22 11	3
4	22 48	16 24	6 16	5 51	16 5	22 29	22 52	17 10	7 4	4 29	15 30	22 19	4
5	22 41	16 6	5 53	6 13	16 22	22 36	22 47	16 54	6 42	4 53	15 49	22 26	5
6	22 35	15 48	5 30	6 36	16 39	22 42	22 41	16 38	6 19	5 16	16 7	22 34	6
7	22 27	15 29	5 7	6 59	16 55	22 48	22 34	16 21	5 57	5 39	16 25	22 40	7
8	22 20	15 10	4 43	7 21	17 12	22 53	22 28	16 4	5 34	6 2	16 42	22 47	8
9	22 12	14 51	4 20	7 43	17 28	22 59	22 20	15 47	5 12	6 24	16 59	22 53	9
10	22 3	14 32	3 56	8 6	17 43	23 3	22 13	15 29	4 49	6 47	17 16	22 58	10
11	21 54	14 13	3 33	8 28	17 59	23 7	22 5	15 11	4 26	7 10	17 33	23 3	11
12	21 45	13 53	3 9	8 50	18 14	23 11	21 57	14 53	4 3	7 33	17 49	23 8	12
13	21 35	13 33	2 46	9 11	18 29	23 15	21 48	14 35	3 40	7 55	18 5	23 12	13
14	21 25	13 13	2 22	9 33	18 43	23 18	21 39	14 17	3 17	8 17	18 21	23 15	14
15	21 14	12 52	1 58	9 54	18 58	23 20	21 30	13 58	2 54	8 40	18 36	23 18	15
16	21 3	12 32	1 35	10 16	19 11	23 23	21 20	13 39	2 31	9 2	18 51	23 21	16
17	20 52	12 11	1 11	10 37	19 25	23 24	21 10	13 20	2 7	9 24	19 6	23 23	17
18	20 40	11 50	0 47	10 58	19 38	23 26	20 59	13 0	1 44	9 46	19 20	23 25	18
19	20 28	11 29	0 23	11 19	19 51	23 27	20 48	12 41	1 21	10 7	19 34	23 26	19
20	20 15	11 47	0 0 S	11 39	20 4	23 27	20 37	12 21	0 58	10 29	19 48	23 27	20
21	20 2	10 46	0 24 N	11 59	20 16	23 28	20 26	12 1	0 34	10 50	20 1	23 27	21
22	19 49	10 24	0 48	12 20	20 28	23 27	20 14	11 41	0 11N	11 12	20 14	23 27	22
23	19 35	10 2	1 11	12 40	20 39	23 27	20 2	11 21	0 13S.	11 33	20 27	23 27	23
24	19 21	9 40	1 35	12 59	20 51	23 25	19 49	11 0	0 36	11 54	20 39	23 26	24
25	19 6	9 18	1 58	13 19	21 1	23 24	19 36	10 39	0 59	12 15	20 51	23 24	25
26	18 52	8 56	2 22	13 38	21 12	23 22	19 23	10 19	1 23	12 35	21 2	23 22	26
27	18 36	8 33	2 45	13 57	21 22	23 20	13 10	9 57	1 46	12 55	21 13	23 20	27
28	18 21	8 11	3 9	14 16	21 32	23 17	18 56	9 36	2 10	13 16	21 24	23 17	28
29	18 5	7 48	3 32	14 35	21 41	23 14	18 42	9 15	2 33	13 36	21 34	23 13	29
30	17 49		3 55	14 53	21 50	23 10	18 27	8 54	2 56	13 55	21 44	23 9	30
31	17 32		4 19		21 59		18 12	8 32		14 15		23 5	31

Sun's Declination for the Years 1845, 1849, 1853, 1857, &c.

1	23 0	17 3	7 31	4 36	15 7	22 5	23 7	18 1	8 15	3 14	14 29	21 51	1
2	22 55	16 45	7 8	4 59	15 25	22 13	23 3	17 46	7 54	3 37	14 48	22 0	2
3	22 49	16 28	6 45	5 22	15 43	22 20	22 58	17 30	7 31	4 1	15 7	22 9	3
4	22 43	16 10	6 22	5 45	16 0	22 27	22 53	17 14	7 9	4 24	15 26	22 17	4
5	22 36	15 52	5 59	6 8	16 18	22 34	22 48	16 58	6 47	4 47	15 44	22 25	5
6	22 29	15 33	5 36	6 31	16 35	22 41	22 42	16 42	6 25	5 10	16 2	22 32	6
7	22 22	15 15	5 12	6 53	16 51	22 47	22 36	16 25	6 2	5 33	16 20	22 39	7
8	22 14	14 56	4 49	7 16	17 8	22 52	22 29	16 8	5 40	5 56	16 38	22 45	8
9	22 5	14 37	4 26	7 38	17 24	22 57	22 22	15 51	5 17	6 19	16 55	22 51	9
10	21 56	14 17	4 2	8 0	17 39	23 2	22 15	15 33	4 54	6 42	17 12	22 57	10
11	21 47	13 57	3 39	8 22	17 55	23 6	22 7	15 16	4 32	7 4	17 29	23 2	11
12	21 37	13 38	3 15	8 44	18 10	23 10	21 59	14 58	4 9	7 27	17 45	23 7	12
13	21 27	13 17	2 51	9 6	18 25	23 14	21 50	14 39	3 46	7 50	18 1	23 11	13
14	21 17	12 57	2 28	9 28	18 40	23 17	21 41	14 21	3 23	8 12	18 17	23 14	14
15	21 6	12 37	2 4	9 49	18 54	23 20	21 32	14 2	3 0	8 34	18 32	23 18	15
16	20 54	12 16	1 40	10 10	19 8	23 22	21 22	13 44	2 36	8 56	18 48	23 21	16
17	20 43	11 55	1 17	10 32	19 22	23 24	21 12	13 24	2 13	9 18	19 2	23 23	17
18	20 30	11 34	0 53	10 53	19 35	23 25	21 2	13 5	1 50	9 40	19 17	23 25	18
19	20 18	11 12	0 29	11 13	19 48	23 27	20 51	12 46	1 27	10 2	19 31	23 26	19
20	20 5	10 51	0 6 S	11 34	20 1	23 27	20 40	12 26	1 3	10 24	19 45	23 27	20
21	19 52	10 29	0 18 N	11 54	20 13	23 27	20 29	12 6	0 40	10 45	19 58	23 27	21
22	19 38	10 8	0 42	12 15	20 25	23 27	20 17	11 46	0 17N	11 7	20 11	23 27	22
23	19 24	9 46	1 5	12 35	20 37	23 27	20 5	11 26	0 7S.	11 28	20 24	23 27	23
24	19 10	9 23	1 29	12 55	20 48	23 26	19 52	11 5	0 30	11 49	20 36	23 26	24
25	18 55	9 1	1 53	13 14	20 59	23 24	19 39	10 44	0 54	12 9	20 48	23 24	25
26	18 40	8 39	2 16	13 34	21 9	23 23	19 26	10 24	1 17	12 30	20 59	23 23	26
27	18 25	8 16	2 40	13 53	21 19	23 20	19 13	10 3	1 40	12 50	21 11	23 20	27
28	18 9	7 54	3 3	14 12	21 29	23 18	18 59	9 41	2 4	13 11	21 21	23 17	28
29	17 53		3 26	14 30	21 39	23 15	18 45	9 20	2 27	13 31	21 32	23 14	29
30	17 36		3 50	14 49	21 48	23 11	18 31	8 59	2 51	13 50	21 41	23 10	30
31	17 20		4 13		21 56		18 16	8 37		14 10		23 6	31

TABLE 16.

Sun's Declination for the Years 1846, 1850, 1854, 1858, &c.

Days	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Days
	South.	South	South.	North	North	North.	North.	North.	North.	South	South.	South.	
	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	
1	23 1	17 7	7 36	4 30	15 3	22 3	23 8	18 4	8 20	3 8	14 25	21 49	1
2	22 56	16 50	7 14	4 54	15 21	22 11	23 4	17 49	7 59	3 32	14 44	21 58	2
3	22 50	16 32	6 51	5 17	15 39	22 18	23 0	17 34	7 37	3 55	15 3	22 7	3
4	22 44	16 14	6 28	5 39	15 56	22 26	22 55	17 18	7 15	4 18	15 21	22 15	4
5	22 38	15 56	6 5	6 2	16 13	22 33	22 49	17 2	6 52	4 41	15 40	22 23	5
6	22 31	15 38	5 41	6 25	16 30	22 39	22 43	16 46	6 30	5 5	15 58	22 30	6
7	22 23	15 19	5 18	6 48	16 47	22 45	22 37	16 29	6 8	5 28	16 16	22 37	7
8	22 15	15 0	4 55	7 10	17 4	22 51	22 31	16 12	5 45	5 51	16 34	22 44	8
9	22 7	14 41	4 31	7 32	17 20	22 56	22 24	15 55	5 23	6 13	16 51	22 50	9
10	21 58	14 22	4 8	7 55	17 36	23 1	22 16	15 38	5 0	6 36	17 8	22 55	10
11	21 49	14 2	3 44	8 17	17 51	23 5	22 9	15 20	4 37	6 59	17 25	23 1	11
12	21 40	13 43	3 21	8 39	18 6	23 9	22 1	15 2	4 14	7 22	17 41	23 5	12
13	21 30	13 22	2 57	9 1	18 21	23 13	21 52	14 44	3 51	7 44	17 57	23 10	13
14	21 19	13 2	2 34	9 22	18 36	23 16	21 43	14 25	3 28	8 7	18 13	23 14	14
15	21 8	12 42	2 10	9 44	18 50	23 19	21 34	14 7	3 5	8 29	18 29	23 17	15
16	20 57	12 21	1 46	10 5	19 5	23 22	21 25	13 48	2 42	8 51	18 44	23 20	16
17	20 46	12 0	1 23	10 26	19 18	23 24	21 15	13 29	2 19	9 13	18 59	23 22	17
18	20 34	11 39	0 59	10 47	19 32	23 25	21 4	13 10	1 55	9 35	19 13	23 24	18
19	20 21	11 18	0 35	11 8	19 45	23 26	20 54	12 50	1 32	9 57	19 28	23 26	19
20	20 8	10 56	0 11 S	11 29	19 57	23 27	20 43	12 31	1 9	10 19	19 41	23 27	20
21	19 55	10 35	0 12N	11 49	20 10	23 27	20 31	12 11	0 45	10 40	19 55	23 27	21
22	19 42	10 13	0 36	12 10	20 22	23 27	20 20	11 51	0 22	11 1	20 8	23 27	22
23	19 28	9 51	1 0	12 30	20 34	23 27	20 8	11 30	0 1N	11 23	20 21	23 27	23
24	19 13	9 29	1 23	12 50	20 45	23 26	19 55	11 10	0 25S	11 44	20 33	23 26	24
25	18 59	9 7	1 47	13 9	20 56	23 25	19 42	10 49	0 48	12 4	20 45	23 25	25
26	18 44	8 44	2 10	13 29	21 7	23 23	19 29	10 29	1 12	12 25	20 57	23 23	26
27	18 28	8 22	2 34	13 48	21 17	23 21	19 16	10 8	1 35	12 46	21 8	23 21	27
28	18 13	7 59	2 57	14 7	21 27	23 18	19 2	9 46	1 58	13 6	21 19	23 18	28
29	17 57		3 21	14 26	21 36	23 15	18 48	9 25	2 22	13 26	21 29	23 15	29
30	17 40		3 44	14 44	21 46	23 12	18 34	9 4	2 45	13 46	21 39	23 11	30
31	17 24		4 7		21 54		18 19	8 42		14 5		23 7	31

Sun's Declination for the Years 1847, 1851, 1855, 1859, &c.

1	23 2	17 11	7 42	4 25	14 58	22 1	23 9	18 8	8 26	3 3	14 20	21 46	1
2	22 57	16 54	7 19	4 48	15 16	22 9	23 5	17 53	8 4	3 26	14 39	21 56	2
3	22 52	16 37	6 56	5 11	15 34	22 17	23 1	17 38	7 42	3 49	14 58	22 4	3
4	22 46	16 19	6 33	5 34	15 52	22 24	22 56	17 22	7 20	4 13	15 17	22 13	4
5	22 39	16 1	6 10	5 57	16 9	22 31	22 51	17 6	6 58	4 36	15 35	22 21	5
6	22 33	15 42	5 47	6 19	16 26	22 37	22 45	16 50	6 36	4 59	15 54	22 28	6
7	22 25	15 24	5 24	6 42	16 43	22 44	22 39	16 33	6 13	5 22	16 12	22 35	7
8	22 17	15 5	5 1	7 5	16 59	22 49	22 32	16 16	5 51	5 45	16 29	22 42	8
9	22 9	14 46	4 37	7 27	17 16	22 55	22 25	15 59	5 28	6 8	16 47	22 48	9
10	22 1	14 27	4 14	7 49	17 32	23 0	22 18	15 42	5 5	6 31	17 4	22 54	10
11	21 52	14 7	3 50	8 11	17 47	23 4	22 11	15 24	4 43	6 53	17 21	22 59	11
12	21 42	13 47	3 27	8 33	18 3	23 8	22 3	15 6	4 20	7 16	17 37	23 4	12
13	21 32	13 27	3 3	8 55	18 18	23 12	21 54	14 48	3 57	7 39	17 53	23 9	13
14	21 22	13 7	2 39	9 17	18 33	23 15	21 46	14 30	3 34	8 1	18 9	23 13	14
15	21 11	12 47	2 16	9 39	18 47	23 18	21 36	14 11	3 11	8 24	18 25	23 16	15
16	21 0	12 26	1 52	10 0	19 1	23 21	21 27	13 53	2 47	8 46	18 40	23 19	16
17	20 48	12 5	1 28	10 21	19 15	23 23	21 17	13 34	2 24	9 8	18 55	23 22	17
18	20 36	11 44	1 5	10 42	19 28	23 25	21 7	13 14	2 1	9 30	19 10	23 24	18
19	20 24	11 23	0 41	11 3	19 42	23 26	20 56	12 55	1 38	9 52	19 24	23 25	19
20	20 11	11 2	0 17 S	11 24	19 54	23 27	20 45	12 35	1 14	10 13	19 38	23 27	20
21	19 58	10 40	0 6N	11 44	20 7	23 27	20 34	12 15	0 51	10 35	19 52	23 27	21
22	19 45	10 18	0 30	12 5	20 19	23 27	20 22	11 55	0 28	10 56	20 5	23 27	22
23	19 31	9 56	0 54	12 25	20 31	23 27	20 10	11 35	0 4N	11 17	20 18	23 27	23
24	19 17	9 34	1 17	12 45	20 42	23 26	19 58	11 15	0 19S.	11 39	20 30	23 26	24
25	19 2	9 12	1 41	13 5	20 53	23 25	19 46	10 54	0 42	11 59	20 42	23 25	25
26	18 47	8 50	2 5	13 24	21 4	23 23	19 33	10 34	1 6	12 20	20 54	23 23	26
27	18 32	8 27	2 28	13 43	21 14	23 21	19 19	10 13	1 29	12 41	21 5	23 21	27
28	18 17	8 5	2 52	14 2	21 24	23 19	19 6	9 52	1 53	13 1	21 16	23 19	28
29	18 1		3 15	14 21	21 34	23 16	18 52	9 30	2 16	13 21	21 26	23 16	29
30	17 44		3 38	14 40	21 43	23 13	18 38	9 9	2 39	13 41	21 37	23 12	30
31	17 28		4 2		21.52		18 23	8 47		14 1		23 8	31

TABLE 17.

To correct the Sun's Declination.

When Declin. is increasing, {add in W. Long. / sub. in E. Long.} When Declin. is decreasing, {sub. in W. Long. / add in E. Long.}

Long.	Sun's Declination.																									Long.
°	0°	1°	2°	3°	4°	5°	6°	7°	8°	9°	10°	11°	12°	13°	14°	15°	16°	17°	18°	19°	20°	21°	22°	23°	23½°	°
	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	
10	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	10
20	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	20
30	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1	1	1	1	1	1	1	1	0	30
40	3	3	3	3	3	2	3	2	2	2	2	2	2	2	2	2	2	2	2	2	1	1	1	1	0	40
50	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	2	2	2	2	1	1	1	0	50
60	4	4	4	4	4	4	4	4	4	4	4	4	3	3	3	3	3	3	3	2	2	2	1	1	0	60
70	5	5	5	5	5	4	4	4	4	4	4	4	4	4	4	4	3	3	3	3	2	2	2	1	0	70
80	5	5	5	5	5	5	5	5	5	5	5	5	5	4	4	4	4	4	3	3	3	2	2	1	0	80
90	6	6	6	6	6	6	6	6	6	6	5	5	5	5	5	5	4	4	4	4	3	3	2	1	0	90
100	7	7	6	6	6	6	6	6	6	6	6	6	6	6	5	5	5	5	4	4	4	3	2	1	0	100
110	7	7	7	7	7	7	7	7	7	7	7	6	6	6	6	6	5	5	5	4	4	3	3	1	0	110
120	8	8	8	8	8	8	8	7	7	7	7	7	7	7	6	6	6	6	5	5	4	4	3	2	0	120
130	9	8	8	8	8	8	8	8	8	8	8	8	7	7	7	7	6	6	6	5	5	4	3	2	0	130
140	9	9	9	9	9	9	9	9	9	9	8	8	8	8	7	7	7	6	6	6	5	4	3	2	0	140
150	10	10	10	10	10	10	10	9	9	9	9	9	9	8	8	8	7	7	6	6	5	5	4	2	0	150
160	11	11	11	11	10	10	10	10	10	10	10	9	9	9	9	8	8	7	7	6	6	5	4	2	0	160
170	11	11	11	11	11	11	11	10	10	10	10	10	10	9	9	9	8	8	7	7	6	5	4	2	0	170
180	12	12	12	12	12	12	11	11	11	11	11	11	10	10	10	9	9	8	8	7	6	5	4	2	0	180

TABLE 18.

To correct the Sun's Declination to Periods of Four Years.

Periods of 4 years.	January.					February.					March.					Periods of 4 years.
	July.					August.					September.					
	Days.					Days.					Days.					
	1	7	13	19	25	1	7	13	19	25	1	7	13	19	25	
	sub	sub	sub	sub	sub	sub	sub	sub	sub	sub	sub	sub	sub	sub	add	
4	0	0	0	0	0	0	0	1′	1′	1′	1′	1′	1′	1′	1′	4
8	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	8
12	0	1	1	1	1	1	2	2	2	2	2	2	2	2	2	12
16	1	1	1	1	2	2	2	2	2	3	3	3	3	3	3	16
20	1	1	1	2	2	2	3	3	3	3	3	3	3	4	4	20

Periods of 4 years.	April.					May.					June.					Periods of 4 years.
	October.					November.					December.					
	Days.					Days.					Days.					
	1	7	13	19	25	1	7	13	19	25	1	7	13	19	25	
	add	add	add	add	add	add	add	add	add	add	add	add	add	add	add	
4	1	1	1	1	1	1	1′	1′	0′	0′	0′	0	0′	0′	0′	4
8	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	8
12	2	2	2	2	2	2	2	1	1	1	1	1	0	0	0	12
16	3	3	3	3	2	2	2	2	2	1	1	1	0	0	0	16
20	4	3	3	3	3	3	3	2	2	2	1	1	1	0	0	20

TABLE 19.

SEMIDIURNAL AND SEMINOCTURNAL ARCHES.

For finding the time of the Rising and Setting of the Sun, Moon or Stars.

DECLINATION.

Lat.	1	2°	3°	4°	5°	6°	7°	8°	9°	10°	11°	12°	13°	14°	15°	16°	Lat
°	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	°
1	6 0	6 0	6 0	6 0	6 0	6 0	6 0	6 1	6 1	6 1	6 1	6 1	6 1	6 1	6 1	6 1	1
3	6 0	6 0	6 1	6 1	6 1	6 1	6 1	6 2	6 2	6 2	6 2	6 3	6 3	6 3	6 3	6 3	3
5	6 0	6 1	6 1	6 1	6 2	6 2	6 2	6 3	6 3	6 4	6 4	6 4	6 5	6 5	6 5	6 6	5
7	6 0	6 1	6 1	6 2	6 2	6 3	6 3	6 4	6 4	6 5	6 5	6 6	6 6	6 7	6 8	6 8	7
9	6 1	6 1	6 2	6 3	6 3	6 4	6 4	6 5	6 6	6 6	6 7	6 8	6 8	6 9	6 10	6 10	9
11	6 1	6 2	6 2	6 3	6 4	6 5	6 5	6 6	6 7	6 8	6 9	6 9	6 10	6 11	6 12	6 13	11
13	6 1	6 2	6 3	6 4	6 5	6 6	6 6	6 7	6 8	6 9	6 10	6 11	6 12	6 13	6 14	6 15	13
14	6 1	6 2	6 3	6 4	6 5	6 6	6 7	6 8	6 9	6 10	6 11	6 12	6 13	6 14	6 15	6 16	14
15	6 1	6 2	6 3	6 4	6 5	6 6	6 8	6 9	6 10	6 11	6 12	6 13	6 14	6 15	6 16	6 18	15
16	6 1	6 2	6 3	6 5	6 6	6 7	6 8	6 9	6 10	6 12	6 13	6 14	6 15	6 16	6 18	6 19	16
17	6 1	6 2	6 4	6 5	6 6	6 7	6 9	6 10	6 11	6 12	6 14	6 15	6 16	6 17	6 19	6 20	17
18	6 1	6 3	6 4	6 5	6 7	6 8	6 9	6 10	6 12	6 13	6 14	6 16	6 17	6 19	6 20	6 21	18
19	6 1	6 3	6 4	6 6	6 7	6 8	6 10	6 11	6 13	6 14	6 15	6 17	6 18	6 20	6 21	6 23	19
20	6 1	6 3	6 4	6 6	6 7	6 9	6 10	6 12	6 13	6 15	6 16	6 18	6 19	6 21	6 22	6 24	20
21	6 2	6 3	6 5	6 6	6 8	6 9	6 11	6 12	6 14	6 16	6 17	6 19	6 20	6 22	6 24	6 25	21
22	6 2	6 3	6 5	6 6	6 8	6 10	6 11	6 13	6 15	6 16	6 18	6 20	6 21	6 23	6 25	6 27	22
23	6 2	6 3	6 5	6 7	6 9	6 10	6 12	6 14	6 15	6 17	6 19	6 21	6 22	6 24	6 26	6 28	23
24	6 2	6 4	6 5	6 7	6 9	6 11	6 13	6 14	6 16	6 18	6 20	6 22	6 24	6 26	6 27	6 29	24
25	6 2	6 4	6 6	6 7	6 9	6 11	6 13	6 15	6 17	6 19	6 21	6 23	6 25	6 27	6 29	6 31	25
26	6 2	6 4	6 6	6 8	6 10	6 12	6 14	6 16	6 18	6 20	6 22	6 24	6 26	6 28	6 30	6 32	26
27	6 2	6 4	6 6	6 8	6 10	6 12	6 14	6 16	6 19	6 21	6 23	6 25	6 27	6 29	6 31	6 34	27
28	6 2	6 4	6 6	6 9	6 11	6 13	6 15	6 17	6 19	6 22	6 24	6 26	6 28	6 30	6 33	6 35	28
29	6 2	6 4	6 7	6 9	6 11	6 13	6 16	6 18	6 20	6 22	6 25	6 27	6 29	6 32	6 34	6 37	29
30	6 2	6 5	6 7	6 9	6 12	6 14	6 16	6 19	6 21	6 23	6 26	6 28	6 31	6 33	6 36	6 38	30
31	6 2	6 5	6 7	6 10	6 12	6 14	6 17	6 19	6 22	6 24	6 27	6 29	6 32	6 34	6 37	6 40	31
32	6 2	6 5	6 8	6 10	6 13	6 15	6 18	6 20	6 23	6 25	6 28	6 31	6 33	6 36	6 39	6 41	32
33	6 3	6 5	6 8	6 10	6 13	6 16	6 18	6 21	6 24	6 26	6 29	6 32	6 34	6 37	6 40	6 43	33
34	6 3	6 5	6 8	6 11	6 14	6 16	6 19	6 22	6 25	6 27	6 30	6 33	6 36	6 39	6 42	6 45	34
35	6 3	6 6	6 8	6 11	6 14	6 17	6 20	6 23	6 25	6 28	6 31	6 34	6 37	6 40	6 43	6 46	35
36	6 3	6 6	6 9	6 12	6 15	6 18	6 20	6 23	6 26	6 29	6 32	6 36	6 39	6 42	6 45	6 48	36
37	6 3	6 6	6 9	6 12	6 15	6 18	6 21	6 24	6 27	6 31	6 34	6 37	6 40	6 43	6 47	6 50	37
38	6 3	6 6	6 9	6 13	6 16	6 19	6 22	6 25	6 28	6 32	6 35	6 38	6 42	6 45	6 48	6 52	38
39	6 3	6 6	6 10	6 13	6 16	6 20	6 23	6 26	6 29	6 33	6 36	6 40	6 43	6 47	6 50	6 54	39
40	6 3	6 7	6 10	6 13	6 17	6 20	6 24	6 27	6 31	6 34	6 38	6 41	6 45	6 48	6 52	6 56	40
41	6 3	6 7	6 10	6 14	6 17	6 21	6 25	6 28	6 32	6 35	6 39	6 43	6 46	6 50	6 54	6 58	41
42	6 4	6 7	6 11	6 14	6 18	6 22	6 25	6 29	6 33	6 37	6 40	6 44	6 48	6 52	6 56	7 0	42
43	6 4	6 7	6 11	6 15	6 19	6 22	6 26	6 30	6 34	6 38	6 42	6 46	6 50	6 54	6 58	7 2	43
44	6 4	6 8	6 12	6 15	6 19	6 23	6 27	6 31	6 35	6 39	6 43	6 47	6 52	6 56	7 0	7 4	44
45	6 4	6 8	6 12	6 16	6 20	6 24	6 28	6 32	6 36	6 41	6 45	6 49	6 53	6 58	7 2	7 7	45
46	6 4	6 8	6 12	6 17	6 21	6 25	6 29	6 33	6 38	6 42	6 46	6 51	6 55	7 0	7 4	7 9	46
47	6 4	6 9	6 13	6 17	6 22	6 26	6 30	6 35	6 39	6 44	6 48	6 53	6 57	7 2	7 7	7 12	47
48	6 4	6 9	6 13	6 18	6 22	6 27	6 31	6 36	6 41	6 45	6 50	6 55	6 59	7 4	7 9	7 14	48
49	6 5	6 9	6 14	6 18	6 23	6 28	6 32	6 37	6 42	6 47	6 52	6 57	7 2	7 7	7 12	7 17	49
50	6 5	6 10	6 14	6 19	6 24	6 29	6 34	6 39	6 44	6 49	6 54	6 59	7 4	7 9	7 14	7 20	50
51	6 5	6 10	6 15	6 20	6 25	6 30	6 35	6 40	6 45	6 50	6 56	7 1	7 6	7 12	7 17	7 23	51
52	6 5	6 10	6 15	6 21	6 26	6 31	6 36	6 41	6 47	6 52	6 58	7 3	7 9	7 14	7 20	7 26	52
53	6 5	6 11	6 16	6 21	6 27	6 32	6 38	6 43	6 49	6 54	7 0	7 6	7 11	7 17	7 23	7 29	53
54	6 6	6 11	6 17	6 22	6 28	6 33	6 39	6 45	6 50	6 56	7 2	7 8	7 14	7 20	7 27	7 33	54
55	6 6	6 11	6 17	6 23	6 29	6 35	6 40	6 46	6 52	6 58	7 4	7 11	7 17	7 23	7 30	7 37	55
56	6 6	6 12	6 18	6 24	6 30	6 36	6 42	6 48	6 54	7 1	7 7	7 13	7 20	7 27	7 34	7 41	56
57	6 6	6 12	6 19	6 25	6 31	6 37	6 44	6 50	6 56	7 3	7 10	7 16	7 23	7 30	7 37	7 45	57
58	6 6	6 13	6 19	6 26	6 32	6 39	6 45	6 52	6 59	7 6	7 12	7 20	7 27	7 34	7 42	7 49	58
59	6 7	6 13	6 20	6 27	6 33	6 40	6 47	6 54	7 1	7 8	7 16	7 23	7 30	7 38	7 46	7 54	59
60	6 7	6 14	6 21	6 28	6 35	6 42	6 49	6 56	7 4	7 11	7 19	7 26	7 34	7 42	7 51	7 59	60
61	6 7	6 14	6 22	6 29	6 36	6 44	6 51	6 59	7 6	7 14	7 22	7 30	7 38	7 47	7 56	8 5	61
62	6 8	6 15	6 23	6 30	6 38	6 46	6 53	7 1	7 9	7 17	7 26	7 34	7 43	7 52	8 1	8 11	62
63	6 8	6 16	6 24	6 32	6 40	6 48	6 56	7 4	7 12	7 21	7 30	7 39	7 48	7 57	8 7	8 17	63
64	6 8	6 16	6 25	6 33	6 41	6 50	6 58	7 7	7 16	7 25	7 34	7 43	7 53	8 3	8 13	8 24	64
65	6 9	6 17	6 26	6 34	6 43	6 52	7 1	7 10	7 19	7 29	7 39	7 48	7 59	8 9	8 20	8 32	65
66	6 9	6 18	6 27	6 36	6 45	6 55	7 4	7 14	7 23	7 33	7 42	7 54	8 5	8 16	8 28	8 40	66

TABLE 19.

SEMIDIURNAL AND SEMINOCTURNAL ARCHES.

For finding the Time of the Rising and Setting of the Sun, Moon or Stars.

DECLINATION.

Lat.	17°	18°	19°	20°	21°	22°	23°	24°	25°	26°	27°	28°	29°	30°	Lat
°	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	°
1	6 1	6 1	6 1	6 1	6 2	6 2	6 2	6 2	6 2	6 2	6 2	6 2	6 2	6 2	1
3	6 4	6 4	6 4	6 4	6 5	6 5	6 5	6 5	6 6	6 6	6 6	6 6	6 7	6 7	3
5	6 6	6 7	6 7	6 7	6 8	6 8	6 9	6 9	6 9	6 10	6 10	6 11	6 11	6 12	5
7	6 9	6 9	6 10	6 10	6 11	6 11	6 12	6 13	6 13	6 14	6 14	6 15	6 16	6 16	7
9	6 11	6 12	6 13	6 13	6 14	6 15	6 15	6 16	6 17	6 18	6 19	6 19	6 20	6 21	9
11	6 14	6 14	6 15	6 16	6 17	6 18	6 19	6 20	6 21	6 22	6 23	6 24	6 25	6 26	11
13	6 16	6 17	6 18	6 19	6 20	6 21	6 22	6 24	6 25	6 26	6 27	6 28	6 29	6 31	13
14	6 17	6 19	6 20	6 21	6 22	6 23	6 24	6 25	6 27	6 28	6 29	6 30	6 32	6 33	14
15	6 19	6 20	6 21	6 22	6 24	6 25	6 26	6 27	6 29	6 30	6 31	6 33	6 34	6 36	15
16	6 20	6 21	6 23	6 24	6 25	6 27	6 28	6 29	6 31	6 32	6 34	6 35	6 37	6 38	16
17	6 21	6 23	6 24	6 26	6 27	6 28	6 30	6 31	6 33	6 34	6 36	6 37	6 39	6 41	17
18	6 23	6 24	6 26	6 27	6 29	6 30	6 32	6 33	6 35	6 36	6 38	6 40	6 41	6 43	18
19	6 24	6 26	6 27	6 29	6 30	6 32	6 34	6 35	6 37	6 39	6 40	6 42	6 44	6 46	19
20	6 26	6 27	6 29	6 30	6 32	6 34	6 36	6 37	6 39	6 41	6 43	6 45	6 47	6 49	20
21	6 27	6 29	6 30	6 32	6 34	6 36	6 38	6 39	6 41	6 43	6 45	6 47	6 49	6 51	21
22	6 28	6 30	6 32	6 34	6 36	6 38	6 39	6 41	6 43	6 45	6 48	6 50	6 52	6 54	22
23	6 30	6 32	6 34	6 36	6 38	6 39	6 42	6 44	6 46	6 48	6 50	6 52	6 54	6 57	23
24	6 31	6 33	6 35	6 37	6 39	6 41	6 44	6 46	6 48	6 50	6 52	6 55	7 57	7 0	24
25	6 33	6 35	6 37	6 39	6 41	6 43	6 46	6 48	6 50	6 53	6 55	6 57	7 0	7 2	25
26	6 34	6 36	6 39	6 41	6 43	6 45	6 48	6 50	6 53	6 55	6 58	7 0	7 3	7 5	26
27	6 36	6 38	6 40	6 43	6 45	6 48	6 50	6 52	6 55	6 58	7 0	7 3	7 6	7 8	27
28	6 37	6 40	6 42	6 45	6 47	6 50	6 52	6 55	6 57	7 0	7 3	7 6	7 9	7 11	28
29	6 39	6 42	6 44	6 47	6 49	6 52	6 54	6 57	7 0	7 3	7 6	7 9	7 12	7 15	29
30	[illegible]	6 43	6 46	6 49	6 51	6 54	6 57	7 0	7 2	7 5	7 8	7 11	7 15	7 18	30
31	[illegible]	6 45	6 48	6 51	6 53	6 56	6 59	7 2	7 5	7 8	7 11	7 14	7 18	7 21	31
32	[illegible]	[illegible]	6 50	6 53	6 56	6 58	7 1	7 5	7 8	7 11	7 14	7 18	7 21	7 25	32
33	[illegible]	[illegible]	6 52	6 55	6 58	7 1	7 4	7 7	7 11	7 14	7 17	7 21	7 24	7 28	33
34	[illegible]	[illegible]	6 54	6 57	7 0	7 3	7 7	7 10	7 13	7 17	7 20	7 24	7 28	7 32	34
35	[illegible]	[illegible]	[illegible]	6 59	7 2	7 6	7 9	7 13	7 16	7 20	7 24	7 27	7 31	7 35	35
36	[illegible]	[illegible]	[illegible]	7 1	7 3	7 8	7 12	7 16	7 19	7 23	7 27	7 31	7 35	7 39	36
37	[illegible]	[illegible]	[illegible]	7 4	7 7	7 11	7 15	7 18	7 22	7 26	7 30	7 34	7 39	7 43	37
38	[illegible]	[illegible]	[illegible]	7 6	7 10	7 14	7 17	7 21	7 25	7 30	7 34	7 38	7 43	7 47	38
39	[illegible]	[illegible]	[illegible]	7 9	7 12	7 16	7 20	7 25	7 29	7 33	7 37	7 42	7 47	7 51	39
40	[illegible]	[illegible]	[illegible]	[illegible]	7 13	7 19	7 23	7 28	7 32	7 37	7 41	7 46	7 51	7 56	40
41	[illegible]	[illegible]	[illegible]	[illegible]	7 15	7 22	7 27	7 31	7 36	7 40	7 45	7 50	7 55	8 0	41
42	[illegible]	[illegible]	[illegible]	[illegible]	7 21	7 25	7 30	7 35	7 39	7 44	7 49	7 55	8 0	6 5	42
43	[illegible]	[illegible]	[illegible]	[illegible]	7 24	7 29	7 33	7 38	7 43	7 48	7 53	7 59	8 4	8 10	43
44	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	7 32	7 37	7 42	7 47	7 52	7 58	8 4	8 9	8 16	44
45	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	7 35	7 40	7 46	7 51	7 57	8 3	8 8	8 15	8 21	45
46	[illegible]	[illegible]	[illegible]	[illegible]	7 34	7 39	7 44	7 50	7 55	8 1	8 7	8 14	8 20	8 27	46
47	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	7 43	7 48	7 54	8 0	8 6	8 12	8 19	8 26	8 33	47
48	[illegible]	[illegible]	[illegible]	[illegible]	7 41	[illegible]	7 53	7 59	8 5	8 11	8 18	8 25	8 32	8 40	48
49	[illegible]	[illegible]	[illegible]	[illegible]	7 43	7 51	7 57	8 3	8 10	8 17	8 24	8 31	8 38	8 46	49
50	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	8 2	8 8	8 15	8 22	8 30	8 37	8 45	8 54	50
51	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	8 6	8 13	8 21	8 28	8 36	8 44	8 53	9 2	51
52	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	8 12	8 19	8 27	8 35	8 43	8 52	9 1	9 11	52
53	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	8 17	8 25	8 33	8 41	8 50	9 0	9 9	9 20	53
54	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	8 31	8 40	8 49	8 58	9 8	9 19	9 30	54
55	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	8 47	8 57	9 7	9 18	9 29	9 42	55
56	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	8 45	8 55	9 5	9 16	9 28	9 41	9 55	56
57	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	8 53	9 4	9 15	9 27	9 40	9 54	10 11	57
58	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	9 2	9 13	9 25	9 38	9 53	10 10	10 30	58
59	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	9 11	9 24	9 37	9 52	10 9	10 29	10 56	59
60	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	9 22	9 35	9 51	10 8	10 28	10 55	12 0	60
61	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	9 34	9 49	10 7	10 27	10 54	12 0		61
62	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	10 5	10 26	10 54	12 0			62
63	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	10 4	10 25	10 53	12 0				63
64	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	10 24	10 52	12 0					64
65	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	10 51	12 0						65
66	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	12 0							66

TABLE 20.

Apparent Time of the Meridian Passages of the Principal Fixed Stars, on the first day of the month.

Mag	Stars.	Jan.		Feb.		Mar.		Apr.		May		June		July		Aug		Sept.		Oct.		Nov.		Dec.	
		h	m	h	m	h	m	h	m	h	m	h	m	h	m	h	m	h	m	h	m	h	m	h	m
2	γ Algenib......	5	17	3	5	1	16	23	18	21	28	19	26	17	21	15	17	13	21	11	33	9	37	7	34
3	α Schedar.....	5	43	3	31	1	42	23	45	21	54	19	52	17	48	15	43	13	48	12	0	10	3	8	1
3	α Pole star....	6	10	3	58	2	9	0	15	22	20	20	19	18	14	16	9	14	14	12	26	10	30	8	27
2	β Mirach	6	13	4	1	2	12	0	18	22	23	20	20	18	17	16	12	14	17	12	29	10	33	8	30
1	α Achernar....	6	44	4	32	2	43	0	49	22	54	20	52	19	48	16	43	14	48	13	0	11	4	9	0
3	α Arietis......	7	10	4	58	3	9	1	15	23	20	21	18	19	14	17	9	15	14	13	26	11	30	9	26
3	α Menkar.....	8	6	5	54	4	4	2	11	0	20	22	14	20	10	18	5	16	10	14	22	12	26	10	22
	β Algol.......	8	10	5	58	4	7	2	14	0	24	22	17	20	14	18	9	16	14	14	26	12	29	10	26
3	α Perseus.....	8	24	6	13	4	22	2	30	0	39	22	32	20	29	18	24	16	29	14	41	12	44	10	41
1	α Aldebaran...	9	38	7	27	5	37	3	43	1	53	23	46	21	42	19	38	17	42	15	55	14	0	11	55
1	α Capella.....	10	16	8	4	6	14	4	21	2	31	0	28	22	20	20	16	18	20	16	33	14	36	12	33
1	β Rigel.......	10	18	8	7	6	17	4	23	2	33	0	30	22	22	20	18	18	22	16	34	14	39	12	35
2	β Tauri	10	27	8	16	6	26	4	32	2	42	0	39	22	31	20	27	18	31	16	44	14	48	12	44
2	γ Bellatrix. ..	10	28	8	17	6	26	4	33	2	43	0	40	22	32	20	28	18	32	16	45	14	48	12	45
2	δ Orionis	10	35	8	24	6	34	4	40	2	50	0	57	22	39	20	35	18	39	16	51	14	56	12	52
3	ε Orionis......	10	40	8	28	6	38	4	44	2	54	0	52	22	43	20	39	18	43	16	55	15	0	12	56
2	α Columbæ ...	10	46	8	34	6	44	4	51	3	0	0	58	22	49	20	46	18	49	17	1	15	6	13	2
1	α Betelgucse...	10	58	8	46	6	56	5	3	3	11	1	10	23	2	20	58	19	2	17	14	15	18	13	15
1	α Canopus	11	32	9	20	7	32	5	37	3	46	1	44	23	36	21	32	19	36	17	48	15	52	13	49
1	α Sirius.......	11	50	9	37	7	48	5	55	4	3	2	2	23	53	21	50	19	53	18	5	16	9	14	6
1	α Castor......	12	36	10	23	8	34	6	40	4	49	2	48	0	43	22	34	20	39	18	51	16	55	14	51
1	α Procyon	12	42	10	30	8	41	6	47	4	56	2	54	0	50	22	41	20	46	18	58	17	2	14	58
2	β Pollux......	12	47	10	34	8	45	6	52	5	0	2	59	0	55	22	46	20	51	19	2	17	6	15	2
2	ξ Argo Navis..	13	10	10	57	9	8	7	15	5	23	3	21	1	18	23	9	21	14	19	25	17	29	15	25
2	δ Argo Navis..	13	52	11	40	9	50	7	57	6	6	4	3	2	0	23	51	21	56	20	8	18	12	16	8
2	α Alphard.....	14	30	12	19	10	29	8	36	6	45	4	42	2	39	0	34	22	34	20	47	18	51	16	47
1	α Regulus.....	15	10	12	59	11	9	9	16	7	25	5	22	3	18	1	14	23	14	21	27	19	31	17	27
2	β Ursæ Majoris	16	2	13	51	12	1	10	7	8	17	6	14	4	10	2	6	0	10	22	19	20	23	18	19
2	α Dubhe......	16	4	13	53	12	2	10	9	8	19	6	16	4	12	2	8	0	12	22	21	20	24	18	21
3	β Deneb......	16	51	14	40	12	50	10	56	9	6	7	3	4	59	2	55	0	59	23	8	21	12	19	8
2	γ Ursæ Majoris	16	56	14	44	12	54	11	1	9	10	7	8	5	4	3	0	1	4	23	12	21	16	19	13
1	α Crucis......	17	28	15	16	13	27	11	33	9	42	7	40	5	36	3	31	1	36	23	44	21	49	19	45
1	α Spica.......	18	27	16	15	14	26	12	32	10	41	8	39	6	35	4	30	2	35	0	47	22	47	20	43
3	η Benetnach...	18	52	16	39	14	50	12	57	11	6	9	3	7	0	4	55	3	0	1	12	23	12	21	8
1	β Centauri....	19	3	16	50	15	1	13	8	11	16	9	14	7	10	5	6	3	10	1	22	23	22	21	18
2	α Draconis....	19	11	16	59	15	9	13	16	11	25	9	22	7	19	5	14	3	19	1	31	23	30	21	27
1	α Arcturus....	19	19	17	6	15	17	13	24	11	33	9	30	7	27	5	22	3	26	1	39	23	38	21	35
3	γ Seginus.....	19	35	17	24	15	35	13	41	11	50	9	47	7	44	5	39	3	43	1	56	23	56	21	52
3	α Zubenesch...	19	51	17	40	15	51	13	57	12	6	10	3	8	0	5	55	3	59	2	12	0	16	22	8
3	β Zubenelg....	20	18	18	6	16	16	14	24	12	33	10	30	8	27	6	22	4	26	2	39	0	42	22	35
2	α Alphacca....	20	38	18	26	16	36	14	44	12	52	10	50	8	46	6	41	4	45	2	58	1	2	22	54
3	α Serpentis....	20	46	18	34	16	44	14	52	13	1	10	58	8	55	6	50	4	54	3	7	1	10	23	3
1	α Antares.....	21	29	19	17	17	27	15	35	13	44	11	41	9	37	7	33	5	37	3	49	1	53	23	46
2	α Ophiuchi ...	22	37	20	26	18	35	16	41	14	52	12	49	10	45	8	41	6	45	4	57	3	2	0	58
2	γ Draconis....	23	3	20	50	19	1	17	8	15	18	13	15	11	11	9	7	7	11	5	23	3	26	1	24
1	α Lyræ.......	23	41	21	29	19	48	17	46	15	55	13	53	11	49	9	44	7	49	6	1	4	5	2	2
2	α Altair	0	56	22	40	20	51	18	57	17	6	15	4	13	0	10	55	9	0	7	12	5	16	3	12
2	α Pavonis.....	1	26	23	9	21	20	19	27	17	36	15	33	13	30	11	25	9	30	7	42	5	45	3	42
1	α Cygni	1	50	23	33	21	44	19	51	17	59	15	57	13	54	11	49	9	54	8	5	6	9	4	5
3	α Cephei......	2	29	0	16	22	23	20	30	18	38	16	36	14	33	12	28	10	32	8	44	6	48	4	44
3	α Aquarii.....	3	10	0	59	23	4	21	12	19	21	17	18	15	14	13	10	11	14	9	27	7	30	5	27
2	α Gruis.......	3	10	0	55	23	6	21	13	19	22	17	20	15	16	13	11	11	15	9	27	7	31	5	28
1	α Fomalhaut ..	4	1	1	45	0	1	22	3	20	12	18	10	16	6	14	2	12	6	10	18	8	22	6	19
2	β Pegasi......	4	8	1	57	0	7	22	10	20	19	18	17	16	12	14	8	12	12	10	24	8	29	6	25
2	α Markab.....	4	9	1	54	0	9	22	11	20	20	18	18	16	14	14	10	12	14	11	26	8	30	6	27
1	α Andromedæ .	5	13	3	56	1	12	23	14	21	23	19	21	17	17	15	13	13	17	11	30	9	33	7	30

TABLE 21.

For reducing the Time of the Moon's Passage over the Meridian of Greenwich to the Time of her passage over any other Meridian.

Long.	Daily Variation of the Moon's passing the Meridian.														Time from Moon's Southing.
	40′	42′	44′	46′	48′	50′	52′	54′	56′	58′	60′	62′	64′	66′	
0°	0′	0′	0′	0′	0′	0′	0′	0′	0′	0′	0′	0′	0′	0′	0h. 0m.
10	1	1	1	1	1	1	1	1	2	2	2	2	2	2	0 40
20	2	2	2	2	3	3	3	3	3	3	3	3	4	4	1 20
30	3	3	4	4	4	4	4	4	5	5	5	5	5	5	2 0
40	4	4	5	5	5	6	6	6	6	6	7	7	7	7	2 40
50	6	5	6	6	7	7	7	7	8	8	8	9	9	9	3 20
60	7	6	7	8	8	8	9	9	9	10	10	10	11	11	4 0
70	8	7	9	9	9	10	10	10	11	11	12	12	12	13	4 40
80	9	8	10	10	11	11	12	12	12	13	13	14	14	15	5 20
90	10	9	11	11	12	12	13	13	14	14	15	15	16	16	6 0
100	11	10	12	13	14	14	14	15	16	16	17	17	18	18	6 40
110	12	12	13	14	15	15	16	16	17	18	18	19	20	20	7 20
120	13	13	15	15	16	17	17	18	19	19	20	21	21	22	8 0
130	14	15	16	17	17	18	19	19	20	21	22	22	23	24	8 40
140	16	16	17	18	19	19	20	21	22	23	23	24	25	26	9 20
150	17	17	18	19	20	21	22	22	23	24	25	26	27	27	10 0
160	18	19	20	20	21	22	23	24	25	26	27	28	28	29	10 40
170	19	20	21	22	23	24	25	25	26	27	28	29	30	31	11 20
180	20	21	22	23	24	25	26	27	28	29	30	31	32	33	12 0

TABLE 22.

Moon's Augmentation.

Alt.	5°	10°	15°	20°	25°	30°	35°	40°	45°	50°	55°	60°	70°	80°	90°
Aug.	1″	3″	4″	6″	7″	8″	9″	10″	11″	12″	13″	14″	15″	15″	16″

TABLE 23.

To reduce the Moon's HORIZONTAL PARALLAX and SEMIDIAMETER to any Time under the Meridian of Greenwich.

Diff. in 12 Hours.	Greenwich Time after Noon or Midnight.																Diff. in 12 Hours.
	h. m. 0 10	h. m. 0 20	h. m. 0 30	h. m. 0 40	h. m. 0 50	h. m. 1 0	h. m. 2 0	h. m. 3 0	h. m. 4 0	h. m. 5 0	h. m. 6 0	h. m. 7 0	h. m. 8 0	h. m. 9 0	h. m. 10 0	h. m. 11 0	
1″	0″	0″	0″	0″	0″	0″	0″	0″	0″	0″	0″	1″	1″	1″	1″	1″	1″
2	0	0	0	0	0	0	0	0	1	1	1	1	1	2	2	2	2
3	0	0	0	0	0	0	0	1	1	1	1	2	2	2	3	3	3
4	0	0	0	0	0	0	1	1	1	2	2	2	3	3	3	4	4
5	0	0	0	0	0	0	1	1	2	2	2	3	3	4	4	5	5
6	0	0	0	0	0	0	1	1	2	2	3	3	4	5	5	6	6
7	0	0	0	0	0	1	1	2	2	3	3	4	5	5	6	6	7
8	0	0	0	0	1	1	1	2	3	3	4	5	5	6	7	7	8
9	0	0	0	0	1	1	1	2	3	4	4	5	6	7	8	8	9
10	0	0	0	1	1	1	2	2	3	4	5	6	7	8	8	9	10
11	0	0	0	1	1	1	2	3	4	5	5	6	7	8	9	10	11
12	0	0	0	1	1	1	2	3	4	5	6	7	8	9	10	11	12
13	0	0	1	1	1	1	2	3	4	5	6	8	9	10	11	12	13
14	0	0	1	1	1	1	2	3	5	6	7	8	9	11	12	13	14
15	0	0	1	1	1	1	2	4	5	6	7	9	10	11	13	14	15
16	0	0	1	1	1	1	3	4	5	7	8	9	11	12	13	15	16
17	0	0	1	1	1	1	3	4	6	7	8	10	11	13	14	16	17
18	0	0	1	1	1	1	3	4	6	7	9	11	12	14	15	17	18
19	0	1	1	1	1	2	3	5	6	8	9	11	13	14	16	17	19
20	0	1	1	1	1	2	3	5	7	8	10	12	13	15	17	18	20
21	0	1	1	1	1	2	3	5	7	9	10	12	14	16	18	19	21
22	0	1	1	1	2	2	4	5	7	9	11	13	15	17	18	20	22
23	0	1	1	1	2	2	4	6	8	10	11	13	15	17	19	21	23
24	0	1	1	1	2	2	4	6	8	10	12	14	16	18	20	22	24
25	0	1	1	1	2	2	4	6	8	10	12	15	17	19	21	23	25
26	0	1	1	1	2	2	4	6	9	11	13	15	17	20	22	24	26
27	0	1	1	1	2	2	4	7	9	11	13	16	18	20	23	25	27
28	0	1	1	2	2	2	5	7	9	12	14	16	19	21	23	26	28
29	0	1	1	2	2	2	5	7	10	12	14	17	19	22	24	27	29
30	0	1	1	2	2	2	5	7	10	12	15	17	20	23	25	28	30

TABLE 24.

Correction of the Moon's Apparent Altitude.

☽ App. Alt.	Horizontal Parallax.									" of Par.	Cor. for " of Par. *add*				
	53'	54'	55'	56'	57'	58'	59'	60'	61'		0"	2"	4"	6"	8"
° '	' "	' "	' "	' "	' "	' "	' "	' "	' "	"	"	"	"	"	"
3 0	38 21	39 21	40 20	41 20	42 20	43 20	44 20	45 20	46 20	0	0	2	4	6	8
10	38 52	39 52	40 52	41 52	42 52	43 51	44 51	45 51	46 51	10	10	12	14	16	18
20	39 21	40 21	41 21	42 21	43 21	44 21	45 21	46 21	47 20	20	20	22	24	26	28
30	39 49	40 49	41 49	42 48	43 48	44 48	45 48	46 48	47 48	30	30	32	34	36	38
40	40 13	41 13	42 14	43 14	44 14	45 14	46 14	47 14	48 14	40	40	42	44	46	48
50	40 39	41 39	42 39	43 39	44 39	45 38	46 38	47 38	48 38	50	50	52	54	56	58
4 0	41 2	42 2	43 2	44 2	45 1	46 1	47 1	48 1	49 1	0	0	2	4	6	8
10	41 24	42 24	43 23	44 23	45 23	46 23	47 23	48 23	49 22	10	10	12	14	16	18
20	41 44	42 44	43 44	44 44	45 43	46 42	47 43	48 43	49 43	20	20	22	24	26	28
30	42 3	43 3	44 3	45 3	46 3	47 2	48 2	49 2	50 2	30	30	32	34	36	38
40	42 21	43 21	44 21	45 21	46 21	47 21	48 20	49 20	50 20	40	40	42	44	46	48
50	42 39	43 39	44 38	45 38	46 38	47 38	48 37	49 37	50 37	50	50	52	54	56	58
5 0	42 55	43 55	44 54	45 54	46 54	47 54	48 54	49 53	50 53	0	0	2	4	6	8
10	43 10	44 10	45 10	46 10	47 9	48 9	49 9	50 9	51 8	10	10	12	14	16	18
20	43 23	44 23	45 24	46 24	47 24	48 24	49 23	50 23	51 23	20	20	22	24	26	28
30	43 37	44 37	45 38	46 38	47 38	48 37	49 37	50 37	51 36	30	30	32	34	36	38
40	43 51	44 51	45 51	46 51	47 51	48 50	49 50	50 50	51 49	40	40	42	44	46	48
50	44 3	45 4	46 3	47 3	48 3	49 3	50 2	51 1	52 2	50	50	52	54	56	58
6 0	44 15	45 16	46 15	47 15	48 15	49 14	50 14	51 14	52 13	0	0	2	4	6	8
10	44 27	45 27	46 26	47 26	48 26	49 25	50 25	51 25	52 24	10	10	12	14	16	18
20	44 38	45 37	46 37	47 37	48 36	49 36	50 35	51 35	52 35	20	20	22	24	26	28
30	44 49	45 47	46 47	47 47	48 46	49 46	50 45	51 45	52 45	30	30	32	34	36	38
40	44 58	45 57	46 57	47 56	48 56	49 55	50 55	51 55	52 54	40	40	42	44	48	48
50	45 7	46 6	47 6	48 5	49 5	50 4	51 4	52 4	53 3	50	50	52	54	56	58
7 0	45 16	46 15	47 14	48 14	49 13	50 13	51 13	52 12	53 12	0	0	2	4	6	8
10	45 24	46 23	47 23	48 22	49 22	50 21	51 21	52 20	53 20	10	10	12	14	16	18
20	45 32	46 31	47 30	48 30	49 29	50 29	51 28	52 28	53 27	20	20	22	24	26	28
30	45 40	46 38	47 38	48 37	49 37	50 36	51 36	52 35	53 35	30	30	32	34	36	38
40	45 47	46 45	47 45	48 44	49 44	50 43	51 43	52 42	53 42	40	40	42	44	46	48
50	45 53	46 52	47 52	48 51	49 51	50 50	51 49	52 49	53 48	50	50	52	54	56	58
8 0	46 0	46 59	47 58	48 58	49 57	50 56	51 56	52 55	53 55	0	0	2	4	6	8
10	46 6	47 5	48 4	49 4	50 3	51 2	52 2	53 1	54 1	10	10	12	14	16	18
20	46 11	47 11	48 10	49 9	50 9	51 8	52 8	53 7	54 6	20	20	22	24	26	28
30	46 17	47 16	48 16	49 15	50 14	51 14	52 13	53 12	54 12	30	30	32	34	36	38
40	46 23	47 22	48 21	49 20	50 20	51 19	52 18	53 17	54 17	40	40	42	44	46	48
50	46 28	47 27	48 26	49 25	50 25	51 24	52 23	53 22	54 22	50	49	51	53	55	57
9 0	46 33	47 31	48 31	49 30	50 29	51 29	52 28	53 27	54 26	0	0	2	4	6	8
10	46 37	47 36	48 35	49 35	50 34	51 33	52 32	53 31	54 31	10	10	12	14	16	18
20	46 41	47 40	48 40	49 39	50 38	51 37	52 36	53 36	54 35	20	20	22	24	26	28
30	46 45	47 45	48 44	49 43	50 42	51 41	52 40	53 40	54 39	30	30	32	34	36	37
40	46 49	47 48	48 47	49 47	50 46	51 45	52 44	53 43	54 43	40	40	42	44	46	48
50	46 53	47 52	48 51	49 50	50 50	51 49	52 48	53 47	54 46	50	49	51	53	55	57

Correction to Minutes of Altitude—*Add*

☽ Alt.	1'	2'	3'	4'	5'	6'	7'	8'	9'	☽ Alt.	1'	2'	3'	4'	5'	6'	7'	8'	9'
3° 0'	3"	6"	9"	13"	16"	19"	22"	25"	28"	6° 0'	1"	2"	3"	4"	5"	7"	8"	9"	10"
10	3	6	9	12	15	18	21	24	27	10	1	2	3	4	5	6	7	8	10
20	2	5	8	11	14	17	19	22	25	20	1	2	3	4	5	6	7	8	9
30	2	5	8	10	13	16	18	21	23	30	1	2	3	4	5	6	7	8	9
40	2	5	7	10	12	15	17	19	22	40	1	2	3	4	5	5	6	7	8
50	2	5	7	9	11	14	16	18	21	50	1	2	3	3	4	5	6	7	8
4 0	2	4	7	9	11	13	15	17	19	7 0	1	2	2	3	4	5	6	7	7
10	2	4	6	8	10	12	14	16	18	10	1	2	2	3	4	5	5	6	7
20	2	4	6	8	10	11	13	15	17	20	1	1	2	3	4	4	5	6	7
30	2	4	5	7	9	11	13	14	16	30	1	1	2	3	3	4	5	6	6
40	2	3	5	7	9	10	12	14	15	40	1	1	2	3	3	4	5	5	6
50	2	3	5	6	8	10	11	13	14	50	1	1	2	3	3	4	5	5	6
5 0	2	3	5	6	8	9	11	12	14	8 0	1	1	2	2	3	3	4	5	5
10	2	3	4	6	7	9	10	12	13	or 10	1	1	2	2	3	3	4	4	5
20	1	3	4	5	7	8	10	11	12	9 20	0	1	1	2	2	3	3	4	4
30	1	3	4	5	6	8	9	10	12	30	0	1	1	2	2	2	3	4	4
40	1	2	4	5	6	7	9	10	11	40	0	1	1	2	2	2	3	3	4
50	1	2	4	5	6	7	8	9	11	50	0	1	1	2	2	2	3	3	3

TABLE 24.

Correction of the Moon's Apparent Altitude.

☾ App. Alt.	Horizontal Parallax.									" of Par.	Cor. for " of Par. add				
	53'	54'	55'	56'	57'	58'	59'	60'	61'		0"	2"	4"	6"	8"
° '	' "	' "	' "	' "	' "	' "	' "	' "	" "	"	"	"	"	"	"
10 0	46 57	47 56	48 55	49 54	50 53	51 52	52 51	53 50	54 49	0	0	2	4	6	8
10	47 0	47 59	48 58	49 57	50 56	51 55	52 54	53 53	54 52	10	10	12	14	16	18
20	47 3	48 2	49 1	50 0	50 59	51 58	52 57	53 56	54 56	20	20	22	24	26	28
30	47 6	48 5	49 4	50 3	51 2	52 1	53 0	53 59	54 58	30	30	31	33	35	37
40	47 9	48 8	49 7	50 6	51 5	52 4	53 3	54 2	55 1	40	40	41	43	45	47
50	47 12	48 11	49 10	50 9	51 8	52 7	53 6	54 4	55 3	50	50	51	53	55	57
11 0	47 14	48 13	49 12	50 11	51 10	52 9	53 8	54 7	55 6	0	0	2	4	6	8
10	47 17	48 16	49 15	50 14	51 12	52 11	53 10	54 9	55 8	10	10	12	14	16	18
20	47 19	48 18	49 17	50 16	51 15	52 13	53 12	54 11	55 10	20	20	22	24	25	27
30	47 22	48 20	49 19	50 18	51 17	52 15	53 14	54 13	55 12	30	29	31	33	35	37
40	47 23	48 22	49 21	50 20	51 19	52 17	53 16	54 15	55 14	40	39	41	43	45	47
50	47 25	48 24	49 23	50 22	51 20	52 19	53 18	54 16	55 15	50	49	51	53	55	57
12 0	47 27	48 26	49 25	50 23	51 22	52 21	53 19	54 18	55 17	0	0	2	4	6	8
10	47 29	48 27	49 26	50 25	51 23	52 22	53 21	54 19	55 18	10	10	12	14	16	18
20	47 31	48 29	49 28	50 26	51 25	52 23	53 22	54 21	55 19	20	20	21	23	25	27
30	47 32	48 30	49 29	50 27	51 26	52 25	53 23	54 22	55 20	30	29	31	33	35	37
40	47 34	48 32	49 30	50 29	51 27	52 26	53 24	54 23	55 21	40	39	41	43	45	47
50	47 35	48 33	49 31	50 30	51 28	52 27	53 25	54 24	55 22	50	49	51	53	55	57
13 0	47 35	48 34	49 32	50 31	51 29	52 28	53 26	54 25	55 23	0	0	2	4	6	8
10	47 36	48 35	49 33	50 32	51 30	52 28	53 27	54 25	55 24	10	10	12	14	16	18
20	47 37	48 36	49 34	50 32	51 31	52 29	53 28	54 26	55 24	20	19	21	23	25	27
30	47 38	48 36	49 35	50 33	51 31	52 30	53 28	54 26	55 25	30	29	31	33	35	37
40	47 39	48 37	49 35	50 34	51 32	52 30	53 29	54 27	55 25	40	39	41	43	45	47
50	47 40	48 38	49 36	50 34	51 32	52 31	53 29	54 27	55 25	50	49	51	53	54	56
14 0	47 40	48 38	49 36	50 35	51 33	52 31	53 29	54 27	55 26	0	0	2	4	6	8
10	47 41	48 39	49 37	50 35	51 33	52 31	53 29	54 28	55 26	10	10	12	14	15	17
20	47 41	48 39	49 37	50 35	51 33	52 31	53 30	54 28	55 26	20	19	21	23	25	27
30	47 41	48 39	49 37	50 35	51 33	52 31	53 30	54 28	55 26	30	29	31	33	35	37
40	47 41	48 39	49 37	50 35	51 33	52 31	53 30	54 28	55 26	40	39	41	43	45	46
50	47 41	48 39	49 37	50 35	51 33	52 31	53 29	54 27	55 25	50	48	50	52	54	56
15 0	47 41	48 39	49 37	50 35	51 33	52 31	53 29	54 27	55 25	0	0	2	4	6	8
10	47 41	48 39	49 37	50 35	51 33	52 31	53 29	54 27	55 25	10	10	12	14	15	17
20	47 41	48 39	49 37	50 35	51 33	52 31	53 28	54 26	55 24	20	19	21	23	25	27
30	47 41	48 39	49 37	50 34	51 32	52 30	53 28	54 26	55 24	30	29	31	33	35	37
40	47 41	48 39	49 36	50 34	51 32	52 30	53 27	54 25	55 23	40	39	40	42	44	46
50	47 40	48 38	49 36	50 34	51 31	52 29	53 27	54 24	55 22	50	48	50	52	54	56
16 0	47 40	48 38	49 35	50 33	51 31	52 28	53 26	54 24	55 21	0	0	2	4	6	8
10	47 40	48 37	49 35	50 32	51 30	52 28	53 25	54 23	55 21	10	10	12	14	15	17
20	47 39	48 37	49 34	50 32	51 29	52 27	53 25	54 22	55 20	20	19	21	23	25	27
30	47 39	48 36	49 33	50 31	51 29	52 26	53 24	54 21	55 19	30	29	31	33	35	37
40	47 39	48 35	49 33	50 30	51 28	52 25	53 23	54 20	55 18	40	39	40	42	44	46
50	47 38	48 34	49 32	50 29	51 27	52 24	53 22	54 19	55 16	50	48	50	52	54	56
17 0	47 37	48 34	49 31	50 28	51 26	52 23	53 21	54 18	55 15	0	0	2	4	6	8
10	47 35	48 33	49 30	50 27	51 25	52 22	53 19	54 17	55 14	10	10	11	13	15	17
20	47 34	48 32	49 29	50 26	51 24	52 21	53 18	54 15	55 13	20	19	21	23	25	27
30	47 34	48 31	49 28	50 25	51 22	52 20	53 17	54 14	55 11	30	29	30	32	34	36
40	47 33	48 30	49 27	50 24	51 21	52 18	53 16	54 13	55 10	40	38	40	42	44	46
50	47 32	48 29	49 26	50 23	51 20	52 17	53 14	54 11	55 8	50	48	50	52	53	55
18 0	47 30	48 27	49 24	50 22	51 19	52 16	53 13	54 10	55 7	0	0	2	4	6	8
10	47 30	48 26	49 23	50 20	51 17	52 14	53 11	54 8	55 5	10	9	11	13	15	17
20	47 28	48 25	49 22	50 19	51 16	52 13	53 10	54 7	55 4	20	19	21	23	25	27
30	47 26	48 23	49 20	50 17	51 14	52 11	53 8	54 5	55 2	30	29	30	32	34	36
40	47 25	48 22	49 19	50 16	51 13	52 9	53 6	54 3	55 0	40	38	40	42	44	46
50	47 24	48 21	49 17	50 14	51 11	52 8	53 5	54 1	54 58	50	47	49	51	53	55
19 0	47 23	48 19	49 16	50 13	51 9	52 6	53 3	54 0	54 56	0	0	2	4	6	8
10	47 21	48 18	49 14	50 11	51 8	52 4	53 1	53 58	54 54	10	9	11	13	15	17
20	47 20	48 16	49 13	50 9	51 6	52 2	52 59	53 56	54 52	20	19	21	23	24	26
30	47 18	48 14	49 11	50 7	51 4	52 1	52 57	53 54	54 50	30	28	30	32	34	36
40	47 16	48 13	49 9	50 6	51 2	51 59	52 55	53 52	54 48	40	38	40	41	43	45
50	47 14	48 11	49 7	50 4	51 0	51 57	52 53	53 49	54 46	50	47	49	51	53	55

Cor. for ' of altitude	add	1'	2'	3'	4'	5'	6'	7'	8'	9'	sub	1'	2'	3'	4'	5'	6'	7'	8'	9'
		0"	0"	0"	0"	1"	1"	1"	1"	2"		0"	0"	0"	0"	1"	1"	1"	1"	1"

Correction of the Moon's Apparent Altitude.

☾ App. Alt.	Horizontal Parallax.									″ of Par.	Cor. for ″ of Par. *add*				
	53′	54′	55′	56′	57′	58′	59′	60′	61′		0″	2″	4″	6″	8′
° ′	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	″	″	″	″	″	″
20 0	47 13	48 9	49 5	50 2	50 58	51 55	52 51	53 47	54 44	0	0	2	4	6	8
10	47 11	48 7	49 3	50 0	50 56	51 52	52 49	53 45	54 41	10	9	11	13	15	17
20	47 10	48 5	49 1	49 58	50 54	51 50	52 46	53 43	54 39	20	19	21	22	24	26
30	47 8	48 3	48 59	49 56	50 52	51 48	52 44	53 40	54 37	30	28	30	32	34	36
40	47 6	48 1	48 57	49 53	50 50	51 46	52 42	53 38	54 34	40	37	39	41	43	45
50	47 4	47 59	48 55	49 51	50 47	51 44	52 40	53 36	54 32	50	47	49	51	52	54
21 0	47 2	47 57	48 53	49 49	50 45	51 41	52 37	53 33	54 29	0	0	2	4	6	7
10	47 0	47 55	48 51	49 47	50 43	51 39	52 35	53 31	54 27	10	9	11	13	15	17
20	46 57	47 53	48 49	49 45	50 40	51 36	52 32	53 28	54 24	20	19	21	22	24	26
30	46 55	47 51	48 46	49 42	50 38	51 34	52 30	53 26	54 21	30	28	30	31	33	35
40	46 53	47 48	48 44	49 40	50 36	51 31	52 27	53 23	54 19	40	37	39	41	43	45
50	46 51	47 46	48 42	49 37	50 33	51 29	52 25	53 20	54 16	50	47	48	50	52	54
22 0	46 49	47 44	48 39	49 35	50 31	51 26	52 22	53 18	54 13	0	0	2	4	6	7
10	46 46	47 41	48 37	49 32	50 28	51 24	52 19	53 15	54 10	10	9	11	13	15	17
20	46 43	47 39	48 34	49 30	50 25	51 21	52 16	53 12	54 7	20	18	20	22	24	26
30	46 41	47 36	48 32	49 27	50 23	51 18	52 14	53 9	54 4	30	28	30	31	33	35
40	46 39	47 34	48 29	49 25	50 20	51 15	52 11	53 6	54 1	40	37	39	41	43	44
50	46 36	47 31	48 27	49 22	50 17	51 13	52 8	53 3	53 58	50	46	48	50	52	54
23 0	46 33	47 29	48 24	49 19	50 14	51 10	52 5	53 0	53 55	0	0	2	4	6	7
10	46 30	47 26	48 21	49 16	50 12	51 7	52 2	52 57	53 52	10	9	11	13	15	17
20	46 27	47 23	48 19	49 14	50 9	51 4	51 59	52 54	53 49	20	18	20	22	24	26
30	46 25	47 21	48 16	49 11	50 6	51 1	51 56	52 51	53 46	30	28	29	31	33	35
40	46 22	47 18	48 13	49 8	50 3	50 58	51 53	52 48	53 43	40	37	39	40	42	44
50	46 20	47 15	48 10	49 5	50 0	50 55	51 50	52 44	53 39	50	46	48	50	51	53
24 0	46 17	47 12	48 7	49 2	49 57	50 52	51 47	52 41	53 36	0	0	2	4	5	7
10	46 14	47 10	48 4	48 59	49 54	50 48	51 43	52 38	53 33	10	9	11	13	15	16
20	46 11	47 7	48 1	48 56	49 51	50 45	51 40	52 35	53 29	20	18	20	22	24	25
30	46 8	47 4	47 58	48 53	49 47	50 42	51 37	52 31	53 26	30	27	29	31	33	35
40	46 5	47 1	47 55	48 50	49 44	50 39	51 33	52 28	53 22	40	36	38	40	42	44
50	46 3	46 58	47 52	48 47	49 41	50 35	51 30	52 24	53 19	50	46	47	49	51	53
25 0	46 0	46 55	47 49	48 43	49 38	50 32	51 27	52 21	53 15	0	0	2	4	5	7
10	45 57	46 52	47 46	48 40	49 34	50 29	51 23	52 17	53 12	10	9	11	13	14	16
20	45 54	46 48	47 43	48 37	49 31	50 25	51 20	52 14	53 8	20	18	20	22	23	25
30	45 51	46 45	47 39	48 34	49 28	50 22	51 16	52 10	53 4	30	27	29	31	32	34
40	45 48	46 42	47 36	48 30	49 24	50 18	51 13	52 7	53 1	40	36	38	40	41	43
50	45 45	46 39	47 33	48 27	49 21	50 15	51 9	52 3	52 57	50	45	47	49	51	52
26 0	45 42	46 36	47 30	48 23	49 17	50 11	51 5	51 59	52 53	0	0	2	4	5	7
10	45 39	46 32	47 26	48 20	49 14	50 8	51 2	51 55	52 49	10	9	11	13	14	16
20	45 35	46 29	47 23	48 17	49 10	50 4	50 58	51 52	52 45	20	18	20	21	23	25
30	45 32	46 26	47 19	48 13	49 7	50 0	50 54	51 48	52 41	30	27	29	30	32	34
40	45 29	46 22	47 16	48 9	49 3	49 57	50 50	51 44	52 38	40	36	38	40	41	43
50	45 26	46 19	47 12	48 6	48 59	49 53	50 46	51 40	52 34	50	45	47	48	50	52
27 0	45 22	46 15	47 9	48 2	48 56	49 49	50 43	51 36	52 30	0	0	2	4	5	7
10	45 19	46 12	47 5	47 59	48 52	49 45	50 39	51 32	52 26	10	9	11	12	14	16
20	45 15	46 8	47 2	47 55	48 48	49 42	50 35	51 28	52 21	20	18	20	21	23	25
30	45 12	46 5	46 58	47 51	48 44	49 38	50 31	51 24	52 17	30	27	28	30	32	34
40	45 8	46 1	46 54	47 47	48 40	49 34	50 27	51 20	52 13	40	35	37	39	41	43
50	45 4	45 58	46 51	47 44	48 37	49 30	50 23	51 16	52 9	50	44	46	48	50	51
28 0	45 1	45 54	46 47	47 40	48 33	49 26	50 19	51 12	52 5	0	0	2	4	5	7
10	44 57	45 50	46 43	47 36	48 29	49 22	50 15	51 8	52 0	10	9	11	12	14	16
20	44 53	45 46	46 39	47 32	48 25	49 17	50 10	51 4	51 56	20	18	19	21	23	25
30	44 50	45 43	46 35	47 28	48 21	49 14	50 6	50 59	51 52	30	26	28	30	32	33
40	44 46	45 39	46 32	47 24	48 17	49 9	50 2	50 55	51 47	40	35	37	39	40	42
50	44 42	45 35	46 28	47 20	48 13	49 5	49 58	50 50	51 43	50	44	46	47	49	51
29 0	44 39	45 31	46 24	47 16	48 9	49 1	49 54	50 46	51 39	0	0	2	4	5	7
10	44 35	45 27	46 20	47 12	48 5	48 57	49 49	50 42	51 34	10	9	10	12	14	16
20	44 31	45 23	46 16	47 8	48 0	48 53	49 45	50 37	51 30	20	17	19	21	23	24
30	44 28	45 19	46 12	47 4	47 56	48 48	49 41	50 33	51 25	30	26	28	30	31	33
40	44 24	45 15	46 8	47 0	47 52	48 44	49 36	50 28	51 20	40	35	37	38	40	42
50	44 20	45 11	46 4	46 56	47 48	48 40	49 32	50 24	51 16	50	44	45	47	49	50

Corr. for ′ of altitude,		1′	2′	3′	4′	5′	6′	7′	8′	9′
	sub	0″	1″	1″	1″	2″	2″	2″	3″	3″

TABLE 24.

Correction of the Moon's Apparent Altitude.

App. Alt.	Horizontal Parallax.									″ of Par.	Cor. for ″ of Par. *add*				
	53′	54′	55′	56′	57′	58′	59′	60′	61′		0″	2″	4″	6″	8″
° ′	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	″	″	″	″	″	″
30 0	44 16	45 7	45 59	46 51	47 43	48 35	49 27	50 19	51 11	0	0	2	3	5	7
10	44 12	45 3	45 55	46 47	47 39	48 31	49 23	50 15	51 7	10	9	10	12	14	16
20	44 8	44 59	45 51	46 43	47 35	48 26	49 18	50 10	51 2	20	17	19	21	22	24
30	44 4	44 55	45 47	46 39	47 30	48 22	49 14	50 5	50 57	30	26	28	29	31	33
40	44 0	44 51	45 43	46 34	47 26	48 17	49 9	50 1	50 52	40	34	36	38	40	41
50	43 55	44 47	45 38	46 30	47 21	48 13	49 4	49 56	50 47	50	43	45	47	48	50
31 0	43 51	44 43	45 34	46 25	47 17	48 8	49 0	49 51	50 43	0	0	2	3	5	7
10	43 47	44 38	45 30	46 21	47 12	48 4	48 55	49 46	50 38	10	9	10	12	14	15
20	43 43	44 34	45 25	46 17	47 8	47 59	48 50	49 42	50 33	20	17	19	20	22	24
30	43 39	44 30	45 21	46 12	47 3	47 54	48 46	49 37	50 28	30	26	27	29	31	32
40	43 35	44 25	45 16	46 8	46 59	47 50	48 41	49 32	50 23	40	34	36	38	39	41
50	43 30	44 21	45 12	46 3	46 54	47 45	48 36	49 27	50 18	50	43	44	46	48	49
32 0	43 25	44 17	45 8	45 58	46 49	47 40	48 31	49 22	50 13	0	0	2	3	5	7
10	43 21	44 12	45 3	45 54	46 45	47 35	48 26	49 17	50 8	10	8	10	12	13	15
20	43 17	44 8	44 58	45 49	46 40	47 31	48 21	49 12	50 3	20	17	19	20	22	24
30	43 13	44 3	44 54	45 45	46 35	47 26	48 16	49 7	49 58	30	25	27	28	30	32
40	43 8	43 59	44 49	45 40	46 30	47 21	48 11	49 2	49 52	40	33	35	37	38	40
50	43 4	43 54	44 45	45 35	46 26	47 16	48 6	48 57	49 47	50	42	44	46	47	49
33 0	43 0	43 50	44 40	45 30	46 21	47 11	48 1	48 52	49 42	0	0	2	3	5	7
10	42 56	43 45	44 35	45 26	46 16	47 6	47 56	48 46	49 37	10	8	10	12	13	15
20	42 51	43 40	44 31	45 21	46 11	47 1	47 51	48 41	49 31	20	17	18	20	22	23
30	42 46	43 36	44 26	45 16	46 6	46 56	47 46	48 36	49 26	30	25	27	28	30	32
40	42 42	43 31	44 21	45 11	46 1	46 51	47 41	48 31	49 21	40	33	35	37	38	40
50	42 37	43 26	44 16	45 6	45 56	46 46	47 36	48 26	49 15	50	42	43	45	47	49
34 0	42 32	43 22	44 12	45 1	45 51	46 41	47 30	48 20	49 10	0	0	2	3	5	7
10	42 27	43 17	44 7	44 56	45 46	46 36	47 25	48 15	49 5	10	8	10	12	13	15
20	42 22	43 12	44 2	44 51	45 41	46 30	47 20	48 9	48 59	20	16	18	20	21	23
30	42 18	43 7	43 57	44 46	45 36	46 25	47 15	48 4	48 54	30	25	26	28	30	32
40	42 14	43 3	43 52	44 41	45 31	46 20	47 9	47 59	48 48	40	33	35	36	38	40
50	42 9	42 58	43 47	44 36	45 25	46 15	47 4	47 53	48 42	50	41	43	44	46	48
35 0	42 4	42 53	43 42	44 31	45 20	46 9	46 59	47 48	48 37	0	0	2	3	5	7
10	41 59	42 48	43 37	44 26	45 15	46 4	46 53	47 42	48 31	10	8	10	11	13	15
20	41 55	42 43	43 32	44 21	45 10	45 59	46 48	47 37	48 26	20	16	18	20	21	23
30	41 50	42 38	43 27	44 16	45 5	45 53	46 42	47 31	48 20	30	24	26	28	29	31
40	41 45	42 33	43 22	44 10	44 59	45 48	46 37	47 26	48 14	40	33	34	36	37	40
50	41 40	42 28	43 17	44 5	44 54	45 43	46 31	47 20	48 8	50	41	42	44	46	47
36 0	41 35	42 23	43 11	44 0	44 49	45 37	46 26	47 14	48 3	0	0	2	3	5	7
10	41 30	42 18	43 6	43 55	44 43	45 32	46 20	47 8	47 57	10	8	10	11	13	15
20	41 25	42 13	43 1	43 49	44 38	45 26	46 14	47 3	47 51	20	16	18	19	21	23
30	41 20	42 8	42 56	43 44	44 32	45 21	46 9	46 57	47 45	30	24	26	27	29	31
40	41 14	42 2	42 51	43 39	44 27	45 15	46 3	46 51	47 39	40	32	34	35	37	39
50	41 9	41 57	42 45	43 33	44 21	45 9	45 57	46 45	47 33	50	40	42	43	45	47
37 0	41 4	41 52	42 40	43 28	44 16	45 3	45 52	46 40	47 28	0	0	2	3	5	6
10	40 59	41 47	42 35	43 22	44 10	44 58	45 46	46 34	47 22	10	8	10	11	13	14
20	40 54	41 42	42 29	43 17	44 5	44 52	45 40	46 28	47 16	20	16	17	19	21	23
30	40 49	41 36	42 24	43 11	43 59	44 47	45 34	46 22	47 9	30	24	25	27	29	31
40	40 43	41 31	42 18	43 6	43 53	44 41	45 28	46 16	47 3	40	32	33	35	36	39
50	40 38	41 26	42 13	43 0	43 48	44 35	45 23	46 10	46 57	50	40	41	43	44	47
38 0	40 33	41 20	42 8	42 55	43 42	44 29	45 17	46 4	46 51	0	0	2	3	5	6
10	40 27	41 15	42 2	42 49	43 36	44 24	45 11	45 58	46 45	10	8	9	11	12	14
20	40 22	41 10	41 57	42 44	43 31	44 18	45 5	45 52	46 39	20	16	17	19	20	22
30	40 17	41 4	41 51	42 38	43 25	44 12	44 59	45 46	46 33	30	23	25	27	28	30
40	40 12	40 59	41 45	42 32	43 19	44 6	44 53	45 40	46 27	40	31	33	34	36	38
50	40 7	40 53	41 40	42 27	43 13	44 0	44 47	45 34	46 20	50	39	41	42	44	45
39 0	40 2	40 48	41 34	42 21	43 8	43 54	44 41	45 27	46 14	0	0	2	3	5	6
10	39 56	40 41	41 29	42 15	43 2	43 48	44 35	45 21	46 8	10	8	9	11	12	14
20	39 50	40 37	41 23	42 9	42 56	43 42	44 29	45 15	46 1	20	15	17	19	20	22
30	39 45	40 31	41 17	42 4	42 50	43 36	44 22	45 9	45 55	30	23	25	26	28	29
40	39 39	40 25	41 12	41 58	42 44	43 30	44 16	45 3	45 49	40	31	32	34	36	37
50	39 34	40 20	41 6	41 52	42 38	43 24	44 10	44 56	45 42	50	39	40	42	43	45

Cor. for ′ of altitude.	*sub*	1′	2′	3′	4′	5′	6′	7′	8′	9′
		1″	1″	2″	2″	3″	3″	4″	4″	5″

TABLE 24.

Correction of the Moon's Apparent Altitude.

☾ App. Alt.	Horizontal Parallax									″ of Par.	Cor. for ″ of Par. *add*				
	53′	54′	55′	56′	57′	58′	59′	60′	61′		0″	2″	4″	6″	8″
° ′	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	″	″	″	″	″	″
40 0	39 28	40 14	41 0	41 46	42 32	43 18	44 4	44 50	45 36	0	0	1	3	5	6
10	39 22	40 8	40 54	41 40	42 26	43 12	43 58	44 44	45 29	10	8	9	11	12	14
20	39 17	40 3	40 49	41 34	42 20	43 6	43 51	44 37	45 22	20	15	17	18	20	21
30	39 11	39 57	40 43	41 28	42 14	43 0	43 45	44 31	45 16	30	23	24	26	27	29
40	39 6	39 51	40 37	41 22	42 8	42 53	43 39	44 24	45 10	40	30	32	33	35	36
50	39 1	39 46	40 31	41 16	42 2	42 47	43 33	44 18	45 3	50	38	40	41	43	44
41 0	38 55	39 40	40 25	41 10	41 56	42 41	43 26	44 11	44 57	0	0	1	3	4	6
10	38 49	39 34	40 19	41 4	41 49	42 35	43 20	44 5	44 50	10	7	9	10	12	13
20	38 44	39 28	40 13	40 58	41 43	42 28	43 13	43 58	44 43	20	15	16	18	19	21
30	38 38	39 22	40 7	40 52	41 37	42 22	43 7	43 52	44 37	30	22	24	25	27	28
40	38 32	39 16	40 1	40 46	41 31	42 16	43 1	43 45	44 30	40	30	31	33	34	36
50	38 26	39 10	39 55	40 40	41 25	42 9	42 54	43 39	44 23	50	37	39	40	42	43
42 0	38 20	39 5	39 49	40 34	41 18	42 3	42 47	43 32	44 17	0	0	1	3	4	6
10	38 14	38 59	39 43	40 28	41 12	41 57	42 41	43 25	44 10	10	7	9	10	12	13
20	38 9	38 53	39 37	40 21	41 6	41 50	42 34	43 19	44 3	20	15	16	18	19	21
30	38 3	38 47	39 31	40 15	40 59	41 44	42 28	43 12	43 56	30	22	24	25	27	28
40	37 57	38 41	39 25	40 9	40 53	41 37	42 21	43 5	43 49	40	29	31	32	34	35
50	37 51	38 35	39 19	40 3	40 47	41 31	42 15	42 59	43 43	50	37	38	40	41	43
43 0	37 45	38 29	39 12	39 56	40 40	41 24	42 8	42 52	43 36	0	0	1	3	4	6
10	37 39	38 22	39 6	39 50	40 34	41 18	42 1	42 45	43 29	10	7	9	10	12	13
20	37 33	38 16	39 0	39 44	40 27	41 11	41 55	42 38	43 22	20	15	16	17	19	21
30	37 27	38 10	38 54	39 37	40 21	41 4	41 48	42 31	43 15	30	22	23	25	26	28
40	37 21	38 4	38 47	39 31	40 14	40 58	41 41	42 24	43 8	40	29	30	32	33	35
50	37 15	37 58	38 41	39 24	40 8	40 51	41 34	42 18	43 1	50	36	38	39	41	42
44 0	37 8	37 52	38 35	39 18	40 1	40 44	41 28	42 11	42 54	0	0	1	3	4	6
10	37 2	37 46	38 29	39 12	39 55	40 38	41 21	42 4	42 47	10	7	9	10	11	13
20	36 56	37 39	38 22	39 5	39 48	40 31	41 14	41 57	42 40	20	14	16	17	19	20
30	36 50	37 33	38 16	38 59	39 41	40 24	41 7	41 50	42 33	30	21	23	24	26	27
40	36 45	37 27	38 9	38 52	39 35	40 17	41 0	41 43	42 25	40	29	30	31	33	34
50	36 39	37 20	38 3	38 46	39 28	40 11	40 53	41 36	42 18	50	36	37	39	40	41
45 0	36 32	37 14	37 57	38 39	39 21	40 4	40 46	41 29	42 11	0	0	1	3	4	6
10	36 25	37 8	37 50	38 32	39 15	39 57	40 39	41 22	42 4	10	7	8	10	11	13
20	36 19	37 1	37 43	38 26	39 8	39 50	40 32	41 14	41 57	20	14	15	17	18	20
30	36 13	36 55	37 37	38 19	39 1	39 43	40 25	41 7	41 49	30	21	22	24	25	27
40	36 6	36 49	37 31	38 12	38 54	39 36	40 18	41 0	41 42	40	28	29	31	32	34
50	36 0	36 42	37 24	38 6	38 48	39 29	40 11	40 53	41 35	50	35	36	38	39	41
46 0	35 54	36 36	37 17	37 59	38 41	39 22	40 4	40 46	41 27	0	0	1	3	4	6
10	35 47	36 29	37 11	37 52	38 34	39 15	39 57	40 39	41 20	10	7	8	10	11	12
20	35 41	36 23	37 4	37 46	38 27	39 8	39 50	40 31	41 13	20	14	15	17	18	19
30	35 35	36 16	36 58	37 39	38 20	39 1	39 43	40 24	41 5	30	21	22	23	25	26
40	35 28	36 10	36 51	37 32	38 13	38 54	39 36	40 17	40 58	40	28	29	30	32	33
50	35 22	36 3	36 44	37 25	38 6	38 47	39 28	40 9	40 50	50	35	36	37	39	40
47 0	35 16	35 57	36 38	37 18	37 59	38 40	39 21	40 2	40 43	0	0	1	3	4	5
10	35 9	35 50	36 31	37 12	37 52	38 33	39 14	39 55	40 36	10	7	8	9	11	12
20	35 3	35 43	36 24	37 5	37 45	38 26	39 7	39 47	40 28	20	14	15	16	18	19
30	34 56	35 37	36 17	36 58	37 38	38 19	38 59	39 40	40 20	30	20	22	23	24	26
40	34 50	35 30	36 10	36 51	37 31	38 12	38 52	39 32	40 13	40	27	28	30	31	32
50	34 44	35 23	36 3	36 44	37 24	38 5	38 45	39 25	40 5	50	34	35	37	38	39
48 0	34 37	35 17	35 57	36 37	37 17	37 57	38 37	39 18	39 58	0	0	1	3	4	5
10	34 30	35 10	35 50	36 30	37 10	37 50	38 30	39 10	39 50	10	7	8	9	11	12
20	34 24	35 3	35 43	36 23	37 3	37 43	38 23	39 3	39 42	20	13	15	16	17	19
30	34 17	34 56	35 36	36 16	36 56	37 36	38 15	38 55	39 35	30	20	21	23	24	25
40	34 10	34 50	35 29	36 9	36 49	37 28	38 8	38 47	39 27	40	27	28	29	31	32
50	34 4	34 43	35 22	36 2	36 41	37 21	38 0	38 40	39 19	50	33	34	36	37	38
49 0	33 57	34 36	35 15	35 55	36 34	37 14	37 53	38 32	39 12	0	0	1	3	4	5
10	33 50	34 29	35 9	35 48	36 27	37 6	37 45	38 25	39 4	10	6	8	9	10	12
20	33 43	34 22	35 2	35 41	36 20	36 59	37 38	38 17	38 56	20	13	14	16	17	18
30	33 36	34 16	34 55	35 34	36 12	36 51	37 30	38 9	38 48	30	19	21	22	23	25
40	33 29	34 9	34 48	35 26	36 5	36 44	37 23	38 2	38 41	40	26	27	29	30	31
50	33 23	34 2	34 39	35 19	35 58	36 37	37 15	37 54	38 33	50	32	34	35	36	38

Cor. for ′ of altitude.										
	sub	1′	2′	3′	4′	5′	6′	7′	8′	9′
		1″	1″	2″	3″	3″	4″	5″	5″	6″

TABLE 24.

Correction of the Moon's Apparent Altitude.

☾ App. Alt.	Horizontal Parallax.									″ of Par.	Cor. for ″ of Par. add				
	53′	54′	55′	56′	57′	58′	59′	60′	61′		0″	2″	4″	6″	8″
° ′	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	″	″	″	″	″	″
50 0	33 16	33 55	34 33	35 12	35 51	36 29	37 8	37 46	38 25	0	0	1	3	4	5
10	33 9	33 48	34 26	35 5	35 43	36 22	37 0	37 39	38 17	10	6	8	9	10	11
20	33 3	33 41	34 19	34 58	35 36	36 14	36 52	37 31	38 9	20	13	14	15	17	18
30	32 56	33 34	34 12	34 50	35 28	36 7	36 45	37 23	38 1	30	19	20	22	23	24
40	32 49	33 27	34 5	34 43	35 21	35 59	36 37	37 15	37 53	40	25	27	28	29	31
50	32 42	33 20	33 58	34 36	35 14	35 52	36 29	37 7	37 45	50	32	33	34	36	37
51 0	32 35	33 13	33 51	34 28	35 6	35 44	36 22	36 59	37 37	0	0	1	2	4	5
10	32 28	33 6	33 43	34 21	34 59	35 36	36 14	36 52	37 29	10	6	7	9	10	11
20	32 21	32 59	33 36	34 14	34 51	35 29	36 6	36 44	37 21	20	12	14	15	16	17
30	32 14	32 52	33 29	34 6	34 44	35 21	35 59	36 36	37 13	30	19	20	21	22	24
40	32 7	32 45	33 22	33 59	34 36	35 13	35 50	36 28	37 5	40	25	26	28	29	30
50	32 0	32 37	33 14	33 52	34 29	35 6	35 42	36 20	36 57	50	31	32	34	35	36
52 0	31 53	32 30	33 7	33 44	34 21	34 58	35 35	36 12	36 49	0	0	1	2	4	5
10	31 46	32 23	33 0	33 37	34 13	34 50	35 27	36 4	36 41	10	6	7	9	10	11
20	31 39	32 16	32 53	33 29	34 6	34 43	35 19	35 56	36 33	20	12	13	15	16	17
30	31 32	32 9	32 45	33 22	33 58	34 35	35 11	35 48	36 24	30	18	19	21	22	23
40	31 25	32 1	32 38	33 14	33 51	34 27	35 3	35 40	36 16	40	24	26	27	28	29
50	31 18	31 54	32 30	33 7	33 43	34 19	34 55	35 32	36 8	50	30	32	33	34	35
53 0	31 11	31 47	32 23	32 59	33 35	34 11	34 48	35 24	36 0	0	0	1	2	4	5
10	31 3	31 40	32 16	32 52	33 28	34 4	34 40	35 15	35 51	10	6	7	8	10	11
20	30 56	31 32	32 8	32 44	33 20	33 56	34 32	35 7	35 43	20	12	13	14	15	17
30	30 49	31 25	32 1	32 36	33 12	33 48	34 24	34 59	35 35	30	18	19	20	21	23
40	30 42	31 18	31 53	32 29	33 4	33 40	34 15	34 51	35 27	40	24	25	26	27	29
50	30 35	31 10	31 46	32 21	32 57	33 32	34 7	34 43	35 18	50	30	31	32	33	35
54 0	30 28	31 3	31 38	32 13	32 49	33 24	33 59	34 35	35 10	0	0	1	2	3	5
10	30 21	30 56	31 31	32 6	32 41	33 16	33 51	34 26	35 2	10	6	7	8	9	10
20	30 13	30 48	31 23	31 58	32 33	33 8	33 43	34 18	34 53	20	12	13	14	15	16
30	30 6	30 41	31 16	31 51	32 25	33 0	33 35	34 10	34 45	30	17	19	20	21	22
40	29 59	30 33	31 8	31 43	32 18	32 52	33 27	34 2	34 36	40	23	24	26	27	28
50	29 52	30 26	31 1	31 35	32 10	32 44	33 19	33 53	34 28	50	29	30	31	32	34
55 0	29 44	30 19	30 53	31 27	32 2	32 36	33 11	33 45	34 19	0	0	1	2	3	5
10	29 36	30 11	30 45	31 20	31 54	32 28	33 2	33 37	34 11	10	6	7	8	9	10
20	29 29	30 4	30 38	31 12	31 46	32 20	32 54	33 28	34 2	20	11	12	14	15	16
30	29 21	29 56	30 30	31 4	31 38	32 12	32 46	33 20	33 54	30	17	18	19	20	22
40	29 14	29 48	30 22	30 56	31 30	32 4	32 38	33 12	33 45	40	23	24	25	26	27
50	29 7	29 41	30 15	30 48	31 22	31 56	32 29	33 3	33 37	50	28	29	31	32	33
56 0	29 0	29 33	30 7	30 40	31 14	31 48	32 21	32 55	33 28	0	0	1	2	3	4
10	28 53	29 26	29 59	30 33	31 6	31 39	32 13	32 46	33 20	10	6	7	8	9	10
20	28 45	29 18	29 51	30 25	30 58	31 31	32 4	32 38	33 11	20	11	12	13	14	15
30	28 37	29 11	29 44	30 17	30 50	31 23	31 56	32 29	33 2	30	17	18	19	20	21
40	28 30	29 3	29 36	30 9	30 42	31 15	31 48	32 21	32 54	40	22	23	24	25	26
50	28 23	28 55	29 28	30 1	30 34	31 7	31 39	32 12	32 45	50	28	29	30	31	32
57 0	28 15	28 48	29 20	29 53	30 26	30 58	31 31	32 4	32 36	0	0	1	2	3	4
10	28 7	28 40	29 12	29 45	30 18	30 50	31 23	31 55	32 28	10	5	6	8	9	10
20	28 0	28 32	29 5	29 37	30 9	30 42	31 14	31 47	32 19	20	11	12	13	14	15
30	27 53	28 25	28 57	29 29	30 1	30 34	31 6	31 38	32 10	30	16	17	18	19	20
40	27 45	28 17	28 49	29 21	29 53	30 25	30 57	31 29	32 1	40	21	23	24	25	26
50	27 38	28 9	28 41	29 13	29 45	30 17	30 49	31 21	31 53	50	27	28	29	30	31
58 0	27 30	28 1	28 33	29 5	29 37	30 9	30 40	31 12	31 44	0	0	1	2	3	4
10	27 22	27 54	28 25	28 57	29 29	30 0	30 32	31 3	31 35	10	5	6	7	8	9
20	27 14	27 46	28 17	28 49	29 20	29 52	30 23	30 55	31 26	20	10	11	13	14	15
30	27 7	27 38	28 9	28 41	29 12	29 43	30 15	30 46	31 17	30	16	17	18	19	19
40	27 0	27 30	28 1	28 33	29 4	29 35	30 6	30 37	31 9	40	21	22	23	24	25
50	26 52	27 22	27 53	28 24	28 55	29 27	29 58	30 29	31 0	50	26	27	28	29	30
59 0	26 44	27 15	27 45	28 16	28 47	29 18	29 49	30 20	30 51	0	0	1	2	3	4
10	26 36	27 7	27 37	28 8	28 39	29 10	29 40	30 11	30 42	10	5	6	7	8	9
20	26 28	26 59	27 29	28 0	28 31	29 1	29 32	30 2	30 33	20	10	11	12	13	14
30	26 20	26 51	27 21	27 52	28 22	28 53	29 23	29 54	30 24	30	15	16	17	18	19
40	26 13	26 43	27 13	27 44	28 14	28 44	29 14	29 45	30 15	40	20	21	22	23	24
50	26 5	26 35	27 5	27 35	28 6	28 36	29 6	29 36	30 6	50	25	26	27	28	29

Corr. for ′ of altitude.	sub	1′	2′	3′	4′	5′	6′	7′	8′	9′
		1″	2″	2″	3″	4″	5″	6″	6″	7″

Correction of the Moon's Apparent Altitude.

☾ App. Alt.		Horizontal Parallax. 53′	54′	55′	56′	57′	58′	59′	60′	61′	″ of Par.	Cor. for ″ of Par. *add* 0″	2″	4″	6″	8″
°	′	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	″	″	″	″	″	″
60	0	25 57	26 27	26 57	27 27	27 57	28 27	28 57	29 27	29 57	0	0	1	2	3	4
	10	25 49	26 19	26 49	27 19	27 49	28 19	28 48	29 18	29 48	10	5	6	7	8	9
	20	25 41	26 11	26 41	27 11	27 40	28 10	28 40	29 9	29 39	20	10	11	12	13	14
	30	25 33	26 3	26 33	27 2	27 32	28 1	28 31	29 0	29 30	30	15	16	17	18	19
	40	25 26	25 55	26 25	26 54	27 23	27 53	28 22	28 52	29 21	40	20	21	22	23	24
	50	25 18	25 47	26 16	26 46	27 15	27 44	28 13	28 43	29 12	50	25	26	27	28	29
61	0	25 10	25 39	26 8	26 37	27 6	27 36	28 5	28 34	29 3	0	0	1	2	3	4
	10	25 2	25 31	26 0	26 29	26 58	27 27	27 56	28 25	28 54	10	5	6	7	8	9
	20	24 54	25 23	25 52	26 21	26 49	27 18	27 47	28 16	28 45	20	10	10	11	12	13
	30	24 47	25 15	25 44	26 12	26 41	27 10	27 38	28 7	28 35	30	14	15	16	17	18
	40	24 39	25 7	25 35	26 4	26 32	27 1	27 29	27 58	28 26	40	19	20	21	22	23
	50	24 31	24 59	25 27	25 56	26 24	26 52	27 21	27 49	28 17	50	24	25	26	27	28
62	0	24 23	24 51	25 19	25 47	26 15	26 43	27 12	27 40	28 8	0	0	1	2	3	4
	10	24 15	24 43	25 11	25 39	26 6	26 35	27 3	27 31	27 59	10	5	6	6	7	8
	20	24 7	24 35	25 2	25 30	25 58	26 26	26 54	27 22	27 50	20	9	10	11	12	13
	30	23 59	24 26	24 54	25 22	25 50	26 17	26 45	27 13	27 40	30	14	15	16	17	18
	40	23 51	24 18	24 46	25 13	25 41	26 8	26 36	27 4	27 31	40	18	19	20	21	22
	50	23 43	24 10	24 37	25 5	25 32	26 0	26 27	26 54	27 22	50	23	24	25	26	27
63	0	23 35	24 2	24 29	24 56	25 25	25 51	26 18	26 45	27 13	0	0	1	2	3	4
	10	23 27	23 54	24 21	24 48	25 15	25 42	26 9	26 36	27 3	10	4	5	6	7	8
	20	23 18	23 45	24 12	24 39	25 6	25 33	26 0	26 27	26 54	20	9	10	11	12	12
	30	23 10	23 37	24 4	24 31	24 58	25 24	25 51	26 18	26 45	30	13	14	15	16	17
	40	23 2	23 29	23 56	24 22	24 49	25 15	25 42	26 9	26 35	40	18	19	20	21	21
	50	22 54	23 21	23 47	24 14	24 40	25 7	25 33	26 0	26 26	50	22	23	24	25	26
64	0	22 46	23 13	23 39	24 5	24 31	24 58	25 24	25 50	26 17	0	0	1	2	3	3
	10	22 38	23 4	23 30	23 57	24 22	24 49	25 15	25 41	26 7	10	4	5	6	7	8
	20	22 29	22 56	23 22	23 48	24 14	24 40	25 6	25 32	25 58	20	9	9	10	11	12
	30	22 21	22 48	23 14	23 39	24 5	24 31	24 57	25 23	25 48	30	13	14	15	15	16
	40	22 13	22 39	23 5	23 31	23 56	24 22	24 48	25 13	25 39	40	17	18	19	20	21
	50	22 5	22 31	22 57	23 22	23 48	24 13	24 39	25 4	25 30	50	22	22	23	24	25
65	0	21 57	22 23	22 48	23 13	23 39	24 4	24 30	24 55	25 20	0	0	1	2	2	3
	10	21 49	22 14	22 40	23 5	23 30	23 55	24 20	24 46	25 11	10	4	5	6	7	7
	20	21 41	22 6	22 31	22 56	23 21	23 46	24 11	24 36	25 1	20	8	9	10	11	12
	30	21 33	21 58	22 23	22 47	23 12	23 37	24 2	24 27	24 52	30	12	13	14	15	16
	40	21 25	21 49	22 14	22 39	23 3	23 28	23 53	24 19	24 43	40	17	17	18	19	20
	50	21 17	21 41	22 5	22 30	22 55	23 19	23 44	24 8	24 33	50	21	22	22	23	24
66	0	21 9	21 32	21 57	22 21	22 46	23 10	23 34	23 59	24 23	0	0	1	2	2	3
	10	21 0	21 24	21 48	22 13	22 37	23 1	23 25	23 50	24 14	10	4	5	6	6	7
	20	20 51	21 16	21 40	22 4	22 28	22 52	23 16	23 40	24 4	20	8	9	10	10	11
	30	20 43	21 7	21 31	21 55	22 19	22 43	23 7	23 31	23 55	30	12	13	14	14	15
	40	20 35	20 59	21 22	21 46	22 10	22 34	22 58	23 21	23 45	40	16	17	18	18	19
	50	20 27	20 50	21 14	21 37	22 1	22 25	22 48	23 12	23 35	50	20	21	21	22	23
67	0	20 19	20 42	21 5	21 29	21 52	22 16	22 39	23 2	23 26	0	0	1	2	2	3
	10	20 10	20 33	20 57	21 20	21 43	22 6	22 30	22 53	23 16	10	4	5	5	6	7
	20	20 1	20 25	20 48	21 11	21 34	21 57	22 20	22 44	23 7	20	8	8	9	10	11
	30	19 53	20 16	20 39	21 2	21 25	21 48	22 11	22 34	22 57	30	11	12	13	14	14
	40	19 45	20 7	20 31	20 53	21 16	21 39	22 2	22 25	22 47	40	15	16	17	18	18
	50	19 37	19 59	20 22	20 45	21 7	21 30	21 52	22 15	22 38	50	19	20	21	21	22
68	0	19 28	19 51	20 13	20 36	20 58	21 21	21 43	22 6	22 28	0	0	1	2	2	3
	10	19 20	19 42	20 4	20 27	20 49	21 11	21 34	21 56	22 18	10	4	4	5	6	7
	20	19 11	19 34	19 56	20 18	20 40	21 2	21 24	21 47	22 9	20	7	8	9	10	10
	30	19 3	19 25	19 47	20 9	20 31	20 53	21 15	21 37	21 59	30	11	12	12	13	14
	40	18 55	19 16	19 38	20 0	20 22	20 44	21 6	21 27	21 49	40	15	15	16	17	18
	50	18 46	19 8	19 30	19 51	20 13	20 35	20 56	21 18	21 39	50	18	19	20	20	21
69	0	18 38	18 59	19 21	19 42	20 4	20 25	20 47	21 8	21 30	0	0	1	1	2	3
	10	18 29	18 51	19 12	19 33	19 55	20 16	20 37	20 58	21 20	10	4	4	5	6	6
	20	18 20	18 42	19 3	19 24	19 46	20 7	20 28	20 49	21 10	20	7	8	8	9	10
	30	18 12	18 34	18 54	19 15	19 36	19 57	20 18	20 39	21 0	30	11	11	12	13	13
	40	18 4	18 25	18 46	19 6	19 27	19 48	20 9	20 30	20 50	40	14	15	15	16	17
	50	17 55	18 16	18 36	18 56	19 17	19 38	19 59	20 19	20 40	50	18	18	19	20	20

Cor. for ′ of altitude.									
sub	1′	2′	3′	4′	5′	6′	7′	8′	9′
	1″	2″	2″	4″	4″	5″	6″	7″	8″

TABLE 24.

Correction of the Moon's Apparent Altitude.

☽ App. Alt.	Horizontal Parallax.									″ of Par.	Cor. for ″ of Par. add				
	53′	54′	55′	56′	57′	58′	59′	60′	61′		0″	2″	4″	6″	8″
° ′	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	″	″	″	″	″	″
70 0	17 47	18 7	18 28	18 48	19 9	19 30	19 50	20 11	20 31	0	0	1	1	2	3
10	17 38	17 59	18 19	18 39	19 0	19 20	19 41	20 1	20 21	10	3	4	5	5	6
20	17 29	17 50	18 10	18 30	18 51	19 11	19 31	19 51	20 11	20	7	7	8	9	9
30	17 21	17 41	18 1	18 21	18 41	19 1	19 22	19 42	20 2	30	10	11	11	12	13
40	17 13	17 33	17 53	18 12	18 32	18 52	19 12	19 32	19 52	40	13	14	15	15	16
50	17 5	17 24	17 44	18 3	18 23	18 43	19 2	19 22	19 42	50	17	17	18	19	19
71 0	16 56	17 15	17 35	17 54	18 14	18 33	18 53	19 12	19 32	0	0	1	1	2	3
10	16 47	17 6	17 26	17 45	18 5	18 24	18 43	19 3	19 22	10	3	4	4	5	6
20	16 39	16 58	17 17	17 36	17 55	18 15	18 34	18 53	19 12	20	6	7	8	8	9
30	16 30	16 50	17 8	17 27	17 46	18 5	18 24	18 43	19 2	30	10	10	11	11	12
40	16 22	16 40	16 59	17 18	17 37	17 56	18 15	18 33	18 52	40	13	13	14	15	15
50	16 13	16 31	16 50	17 9	17 28	17 46	18 5	18 24	18 42	50	16	16	17	18	18
72 0	16 4	16 23	16 41	17 0	17 18	17 37	17 55	18 14	18 32	0	0	1	1	2	2
10	15 56	16 14	16 32	16 51	17 9	17 27	17 46	18 4	18 23	10	3	4	4	5	5
20	15 47	16 5	16 23	16 42	17 0	17 18	17 36	17 54	18 13	20	6	7	7	8	8
30	15 38	15 56	16 14	16 32	16 50	17 9	17 26	17 45	18 3	30	9	10	10	11	11
40	15 30	15 48	16 5	16 23	16 41	16 59	17 17	17 35	17 53	40	12	13	13	14	14
50	15 22	15 39	15 56	16 14	16 32	16 50	17 7	17 25	17 43	50	15	16	16	17	17
73 0	15 13	15 30	15 47	16 5	16 22	16 40	16 58	17 15	17 33	0	0	1	1	2	2
10	15 4	15 21	15 38	15 56	16 13	16 31	16 48	17 5	17 23	10	3	3	4	5	5
20	14 55	15 12	15 29	15 47	16 4	16 21	16 38	16 55	17 13	20	6	6	7	7	8
30	14 46	15 3	15 20	15 37	15 54	16 12	16 29	16 46	17 3	30	9	9	10	10	11
40	14 38	14 54	15 11	15 28	15 45	16 2	16 19	16 36	16 53	40	11	12	12	13	14
50	14 29	14 46	15 2	15 19	15 36	15 52	16 9	16 26	16 43	50	14	15	15	16	16
74 0	14 21	14 37	14 53	15 10	15 26	15 43	15 59	16 16	16 33	0	0	1	1	2	2
10	14 12	14 28	14 44	15 1	15 17	15 33	15 50	16 6	16 22	10	3	3	4	4	5
20	14 3	14 19	14 35	14 51	15 8	15 24	15 40	15 56	16 12	20	5	6	6	7	7
30	13 54	14 10	14 26	14 42	14 58	15 14	15 30	15 46	16 2	30	8	9	9	10	10
40	13 46	14 1	14 17	14 33	14 49	15 5	15 20	15 36	15 52	40	11	11	12	12	13
50	13 37	13 52	14 8	14 24	14 39	14 55	15 11	15 26	15 42	50	13	14	14	15	15
75 0	13 28	13 43	13 59	14 14	14 30	14 45	15 1	15 16	15 32	0	0	1	1	2	2
10	13 19	13 34	13 50	14 5	14 20	14 36	14 51	15 7	15 22	10	3	3	4	4	5
20	13 10	13 25	13 41	13 56	14 11	14 26	14 41	14 57	15 12	20	5	6	6	7	7
30	13 1	13 16	13 32	13 47	14 2	14 17	14 32	14 47	15 2	30	8	8	9	9	10
40	12 52	13 8	13 22	13 37	13 52	14 7	14 22	14 37	14 52	40	10	11	11	12	12
50	12 43	12 59	13 13	13 28	13 43	13 57	14 12	14 27	14 41	50	13	13	14	14	15
76 0	12 35	12 50	13 4	13 19	13 33	13 48	14 2	14 17	14 31	0	0	0	1	1	2
10	12 26	12 41	12 55	13 9	13 24	13 38	13 52	14 7	14 21	10	2	3	3	4	4
20	12 17	12 32	12 46	13 0	13 14	13 28	13 43	13 57	14 11	20	5	5	6	6	7
30	12 8	12 23	12 37	12 51	13 5	13 19	13 33	13 47	14 1	30	7	7	8	8	9
40	11 59	12 14	12 28	12 41	12 55	13 9	13 23	13 37	13 51	40	9	10	10	11	11
50	11 51	12 5	12 18	12 32	12 46	12 59	13 13	13 27	13 40	50	12	12	13	13	14
77 0	11 42	11 56	12 9	12 23	12 36	12 50	13 3	13 17	13 30	0	0	0	1	1	2
10	11 33	11 47	12 0	12 13	12 27	12 40	12 53	13 7	13 20	10	2	3	3	4	4
20	11 24	11 38	11 51	12 4	12 17	12 30	12 43	12 57	13 10	20	4	5	5	6	6
30	11 15	11 29	11 42	11 55	12 8	12 21	12 34	12 47	13 0	30	7	7	7	8	8
40	11 6	11 20	11 32	11 45	11 58	12 11	12 24	12 37	12 49	40	9	9	10	10	10
50	10 58	11 11	11 23	11 36	11 49	12 1	12 14	12 26	12 39	50	11	11	12	12	13
78 0	10 49	11 2	11 14	11 26	11 39	11 51	12 4	12 16	12 29	0	0	0	1	1	2
10	10 40	10 52	11 5	11 17	11 29	11 42	11 54	12 6	12 19	10	2	2	3	3	4
20	10 31	10 43	10 56	11 8	11 20	11 32	11 44	11 56	12 8	20	4	4	5	5	6
30	10 22	10 34	10 46	10 58	11 10	11 22	11 34	11 46	11 58	30	6	6	7	7	8
40	10 14	10 25	10 37	10 49	11 1	11 12	11 24	11 36	11 48	40	8	8	9	9	10
50	10 5	10 16	10 28	10 39	10 51	11 3	11 14	11 26	11 38	50	10	10	11	11	12
79 0	9 56	10 7	10 19	10 30	10 41	10 53	11 4	11 16	11 27	0	0	0	1	1	1
10	9 47	9 58	10 9	10 21	10 32	10 43	10 54	11 6	11 17	10	2	2	3	3	3
20	9 38	9 49	10 0	10 11	10 22	10 33	10 44	10 56	11 7	20	4	4	4	5	5
30	9 29	9 40	9 51	10 2	10 13	10 24	10 35	10 46	10 57	30	5	6	6	7	7
40	9 20	9 31	9 42	9 52	10 3	10 14	10 25	10 35	10 46	40	7	8	8	8	9
50	9 11	9 22	9 32	9 43	9 53	10 4	10 15	10 25	10 36	50	9	9	10	10	11

Cor. for ′ of altitude.		1′	2′	3′	4′	5′	6′	7′	8′	9′
	sub	1″	2″	3″	4″	5″	6″	7″	8″	8″

TABLE 24.

Correction of the Moon's Apparent Altitude.

☽ App. Alt.	Horizontal Parallax.									″ of Par.	Cor. for ″ of Par. *add*				
	53′	54′	55′	56′	57′	58′	59′	60′	61′		0″	2″	4″	6″	8″
° ′	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	″	″	″	″	″	″
80 0	9 2	9 13	9 23	9 33	9 44	9 54	10 5	10 15	10 25	0	0	0	1	1	1
10	8 53	9 3	9 14	9 24	9 34	9 44	9 55	10 5	10 15	10	2	2	2	3	3
20	8 44	8 54	9 4	9 15	9 25	9 35	9 45	9 55	10 5	20	3	4	4	4	5
30	8 35	8 45	8 55	9 5	9 15	9 25	9 35	9 45	9 55	30	5	5	6	6	6
40	8 26	8 36	8 46	8 56	9 5	9 15	9 25	9 34	9 44	40	7	7	7	8	8
50	8 17	8 27	8 37	8 46	8 56	9 5	9 15	9 24	9 34	50	8	9	9	9	10
81 0	8 8	8 18	8 27	8 37	8 46	8 55	9 5	9 14	9 24	0	0	0	1	1	1
10	7 59	8 9	8 18	8 27	8 36	8 46	8 55	9 4	9 13	10	1	2	2	2	3
20	7 50	8 0	8 9	8 18	8 27	8 36	8 45	8 54	9 3	20	3	3	4	4	4
30	7 41	7 50	7 59	8 8	8 17	8 26	8 35	8 44	8 52	30	4	5	5	5	6
40	7 32	7 41	7 50	7 59	8 7	8 16	8 25	8 33	8 42	40	6	6	7	7	7
50	7 23	7 32	7 41	7 49	7 58	8 6	8 15	8 23	8 32	50	7	8	8	8	9
82 0	7 14	7 23	7 31	7 40	7 48	7 56	8 5	8 13	8 21	0	0	0	1	1	1
10	7 5	7 14	7 22	7 30	7 38	7 46	7 55	8 3	8 11	10	1	2	2	2	2
20	6 56	7 5	7 13	7 21	7 29	7 37	7 45	7 53	8 1	20	3	3	3	3	4
30	6 47	6 55	7 3	7 11	7 19	7 27	7 35	7 42	7 50	30	4	4	4	5	5
40	6 38	6 46	6 54	7 2	7 9	7 17	7 25	7 32	7 40	40	5	5	6	6	6
50	6 29	6 37	6 45	6 52	7 0	7 7	7 14	7 22	7 29	50	7	7	7	7	8
83 0	6 20	6 28	6 35	6 42	6 50	6 57	7 4	7 12	7 19	0	0	0	0	1	1
10	6 11	6 19	6 26	6 33	6 40	6 47	6 54	7 2	7 9	10	1	1	2	2	2
20	6 2	6 9	6 16	6 23	6 30	6 37	6 44	6 51	6 58	20	2	2	3	3	3
30	5 53	6 0	6 7	6 14	6 21	6 27	6 34	6 41	6 48	30	3	4	4	4	4
40	5 44	5 51	5 58	6 4	6 11	6 18	6 24	6 31	6 37	40	5	5	5	5	5
50	5 35	5 42	5 48	5 55	6 1	6 8	6 14	6 21	6 27	50	6	6	6	6	7
84 0	5 26	5 33	5 39	5 45	5 52	5 58	6 4	6 10	6 17	0	0	0	0	1	1
10	5 17	5 23	5 30	5 36	5 42	5 48	5 54	6 0	6 6	10	1	1	1	2	2
20	5 8	5 14	5 20	5 26	5 32	5 38	5 44	5 50	5 56	20	2	2	2	2	3
30	4 59	5 5	5 11	5 17	5 22	5 28	5 34	5 40	5 45	30	3	3	3	3	4
40	4 50	4 56	5 1	5 7	5 13	5 18	5 24	5 29	5 35	40	4	4	4	4	5
50	4 41	4 47	4 52	4 57	5 3	5 8	5 14	5 19	5 24	50	5	5	5	5	6
85 0	4 32	4 37	4 43	4 48	4 53	4 58	5 4	5 9	5 14	0	0	0	0	0	1
10	4 23	4 28	4 33	4 38	4 43	4 48	4 53	4 59	5 4	10	1	1	1	1	1
20	4 14	4 19	4 24	4 29	4 34	4 38	4 43	4 48	4 53	20	2	2	2	2	2
30	4 5	4 10	4 14	4 19	4 24	4 29	4 33	4 38	4 43	30	2	2	3	3	3
40	3 56	4 0	4 5	4 10	4 14	4 19	4 23	4 28	4 32	40	3	3	3	4	4
50	3 47	3 51	3 56	4 0	4 4	4 9	4 13	4 17	4 22	50	4	4	4	4	5
86 0	3 38	3 42	3 46	3 50	3 55	3 59	4 3	4 7	4 11	0	0	0	0	0	0
10	3 29	3 33	3 37	3 41	3 45	3 49	3 53	3 57	4 1	10	1	1	1	1	1
20	3 20	3 24	3 27	3 31	3 35	3 39	3 43	3 47	3 50	20	1	1	1	2	2
30	3 11	3 14	3 18	3 22	3 25	3 29	3 33	3 36	3 40	30	2	2	2	2	2
40	3 2	3 5	3 9	3 12	3 16	3 19	3 23	3 26	3 30	40	2	3	3	3	3
50	2 53	2 56	2 59	3 2	3 6	3 9	3 12	3 16	3 19	50	3	3	3	3	4
87 0	2 43	2 46	2 50	2 53	2 56	2 59	3 2	3 5	3 9	0	0	0	0	0	0
10	2 34	2 37	2 40	2 43	2 46	2 49	2 52	2 55	2 58	10	0	1	1	1	1
20	2 25	2 28	2 31	2 34	2 36	2 39	2 42	2 45	2 48	20	1	1	1	1	1
30	2 16	2 19	2 21	2 24	2 27	2 29	2 32	2 35	2 37	30	1	1	1	2	2
40	2 7	2 10	2 12	2 14	2 17	2 19	2 22	2 24	2 27	40	2	2	2	2	2
50	1 58	2 0	2 3	2 5	2 7	2 9	2 12	2 14	2 16	50	2	2	2	2	3
88 0	1 49	1 51	1 53	1 55	1 57	1 59	2 2	2 4	2 6	0	0	0	0	0	0
10	1 40	1 42	1 44	1 46	1 48	1 50	1 51	1 53	1 55	10	0	0	0	0	0
20	1 31	1 33	1 34	1 36	1 38	1 40	1 41	1 43	1 45	20	1	1	1	1	1
30	1 22	1 23	1 25	1 26	1 28	1 30	1 31	1 33	1 34	30	1	1	1	1	1
40	1 13	1 14	1 15	1 17	1 18	1 20	1 21	1 22	1 24	40	1	1	1	1	1
50	1 4	1 5	1 6	1 7	1 8	1 10	1 11	1 12	1 13	50	1	1	1	1	2
89 0	0 55	0 56	0 57	0 58	0 59	1 0	1 1	1 2	1 3	0	0	0	0	0	0
10	0 45	0 46	0 47	0 48	0 49	0 50	0 51	0 52	0 52	10	0	0	0	0	0
20	0 36	0 37	0 38	0 38	0 39	0 40	0 41	0 41	0 42	20	0	0	0	0	0
30	0 27	0 28	0 28	0 29	0 29	0 30	0 30	0 31	0 31	30	0	0	0	0	0
40	0 18	0 18	0 19	0 19	0 20	0 20	0 20	0 21	0 21	40	0	0	0	0	0
50	0 9	0 9	0 9	0 10	0 10	0 10	0 10	0 10	0 10	50	1	1	1	1	1

Cor. for ′ of altitude.									
sub	1′2	3′	4′	5′	6′	7′	8′	9′	
	1″	2″	3″	4″	5″	6″	7″	8″	9″

TABLE 25.

To reduce the Sun's Right Ascension to any given Meridian, and to any Time under that Meridian.

{ Add in W. long.
Sub. in E. long. }

{ Add aft. noon.
Sub. bef. noon. }

Long.	Sun's Right Ascension.												Time fr. Noon.
	0h.	1h.	2h.	3h.	4h.	5h.	6h.	7h.	8h.	9h.	10h	11h	
°	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	h m.
0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0
3	0 2	0 2	0 2	0 2	0 2	0 2	0 2	0 2	0 2	0 2	0 2	0 2	0 12
6	0 4	0 4	0 4	0 4	0 4	0 4	0 4	0 4	0 4	0 4	0 4	0 4	0 24
9	0 6	0 6	0 6	0 6	0 6	0 6	0 6	0 6	0 6	0 6	0 6	0 5	0 36
12	0 7	0 7	0 7	0 8	0 8	0 8	0 8	0 8	0 8	0 8	0 7	0 7	0 48
15	0 9	0 9	0 9	0 10	0 10	0 10	0 10	0 10	0 10	0 10	0 9	0 9	1 0
18	0 11	0 11	0 11	0 12	0 12	0 12	0 12	0 12	0 12	0 11	0 11	0 11	1 12
21	0 13	0 13	0 13	0 14	0 14	0 14	0 14	0 14	0 14	0 13	0 13	0 13	1 24
24	0 15	0 15	0 15	0 15	0 16	0 16	0 17	0 16	0 16	0 15	0 15	0 14	1 36
27	0 16	0 16	0 17	0 17	0 18	0 18	0 19	0 18	0 18	0 17	0 17	0 16	1 48
30	0 18	0 18	0 19	0 19	0 20	0 21	0 21	0 21	0 20	0 19	0 18	0 18	2 0
33	0 20	0 20	0 21	0 21	0 22	0 23	0 23	0 23	0 22	0 21	0 20	0 20	2 12
36	0 22	0 22	0 22	0 23	0 24	0 25	0 25	0 25	0 24	0 23	0 22	0 22	2 24
39	0 24	0 24	0 24	0 25	0 26	0 27	0 27	0 27	0 26	0 25	0 24	0 23	2 36
42	0 25	0 25	0 26	0 27	0 28	0 29	0 29	0 29	0 28	0 27	0 26	0 25	2 48
45	0 27	0 27	0 28	0 29	0 30	0 31	0 31	0 31	0 30	0 29	0 28	0 27	3 0
48	0 29	0 29	0 30	0 31	0 32	0 33	0 33	0 33	0 32	0 31	0 30	0 29	3 12
51	0 31	0 31	0 32	0 33	0 34	0 35	0 35	0 35	0 34	0 33	0 32	0 31	3 24
54	0 33	0 33	0 34	0 35	0 36	0 37	0 37	0 37	0 36	0 35	0 33	0 32	3 36
57	0 35	0 35	0 36	0 37	0 38	0 39	0 39	0 39	0 38	0 36	0 35	0 34	3 48
60	0 36	0 36	0 37	0 39	0 40	0 41	0 42	0 41	0 40	0 38	0 37	0 36	4 0
63	0 38	0 38	0 39	0 41	0 42	0 43	0 44	0 43	0 42	0 40	0 39	0 38	4 12
66	0 40	0 40	0 41	0 43	0 44	0 45	0 46	0 45	0 44	0 42	0 41	0 40	4 24
69	0 42	0 42	0 43	0 45	0 46	0 47	0 48	0 47	0 46	0 44	0 42	0 41	4 36
72	0 44	0 44	0 45	0 46	0 48	0 49	0 50	0 49	0 48	0 46	0 44	0 43	4 48
75	0 45	0 46	0 47	0 48	0 50	0 51	0 52	0 51	0 50	0 48	0 46	0 45	5 0
78	0 47	0 47	0 49	0 50	0 52	0 54	0 54	0 53	0 52	0 50	0 48	0 47	5 12
81	0 49	0 49	0 50	0 52	0 54	0 56	0 56	0 55	0 54	0 52	0 50	0 49	5 24
84	0 51	0 51	0 52	0 54	0 56	0 58	0 58	0 58	0 56	0 54	0 52	0 50	5 36
87	0 53	0 53	0 54	0 56	0 58	1 0	1 0	1 0	0 58	0 56	0 54	0 52	5 48
90	0 54	0 55	0 56	0 58	1 0	1 2	1 2	1 2	1 0	0 58	0 55	0 54	6 0
93	0 56	0 56	0 58	1 0	1 2	1 4	1 4	1 4	1 2	1 0	0 57	0 56	6 12
96	0 58	0 58	1 0	1 2	1 4	1 6	1 6	1 6	1 4	1 2	0 59	0 58	6 24
99	1 0	1 0	1 2	1 4	1 6	1 8	1 9	1 8	1 6	1 3	1 1	0 59	6 36
102	1 2	1 2	1 3	1 6	1 8	1 10	1 11	1 10	1 8	1 5	1 3	1 1	6 48
105	1 4	1 4	1 5	1 8	1 10	1 12	1 13	1 12	1 10	1 7	1 5	1 3	7 0
108	1 5	1 6	1 7	1 10	1 12	1 14	1 15	1 14	1 12	1 9	1 7	1 5	7 12
111	1 7	1 7	1 9	1 12	1 14	1 16	1 17	1 16	1 14	1 11	1 8	1 7	7 24
114	1 9	1 9	1 11	1 14	1 16	1 18	1 19	1 18	1 16	1 13	1 10	1 9	7 36
117	1 11	1 11	1 13	1 16	1 18	1 20	1 21	1 20	1 18	1 15	1 12	1 10	7 48
120	1 13	1 13	1 15	1 17	1 20	1 22	1 23	1 22	1 20	1 17	1 14	1 12	8 0
123	1 14	1 15	1 17	1 19	1 22	1 25	1 25	1 24	1 22	1 19	1 16	1 14	8 12
126	1 16	1 16	1 18	1 21	1 24	1 27	1 27	1 26	1 24	1 21	1 18	1 16	8 24
129	1 18	1 18	1 20	1 23	1 26	1 29	1 29	1 28	1 26	1 23	1 19	1 18	8 36
132	1 20	1 20	1 22	1 25	1 28	1 31	1 31	1 30	1 28	1 25	1 21	1 19	8 48
135	1 22	1 22	1 24	1 27	1 30	1 33	1 34	1 32	1 30	1 26	1 23	1 21	9 0
138	1 24	1 24	1 26	1 29	1 32	1 35	1 36	1 35	1 32	1 28	1 25	1 23	9 12
141	1 26	1 26	1 28	1 31	1 34	1 37	1 38	1 37	1 34	1 30	1 27	1 25	9 24
144	1 27	1 27	1 30	1 33	1 36	1 39	1 40	1 39	1 36	1 32	1 29	1 27	9 36
147	1 29	1 29	1 32	1 35	1 38	1 41	1 42	1 41	1 38	1 34	1 31	1 28	9 48
150	1 31	1 31	1 33	1 37	1 40	1 43	1 44	1 43	1 40	1 36	1 32	1 30	10 0
153	1 33	1 33	1 35	1 39	1 42	1 45	1 46	1 45	1 42	1 38	1 34	1 32	10 12
156	1 34	1 35	1 37	1 41	1 44	1 47	1 48	1 47	1 44	1 40	1 36	1 34	10 24
159	1 36	1 37	1 39	1 43	1 46	1 49	1 50	1 49	1 46	1 42	1 38	0 36	10 36
162	1 38	1 38	1 41	1 45	1 48	1 51	1 52	1 51	1 48	1 44	1 40	1 37	10 48
165	1 40	1 40	1 43	1 46	1 50	1 53	1 54	1 53	1 50	1 46	1 42	1 39	11 0
168	1 42	1 42	1 45	1 48	1 52	1 55	1 56	1 55	1 52	1 48	1 44	1 41	11 12
171	1 44	1 44	1 46	1 50	1 54	1 57	1 59	1 57	1 54	1 49	1 45	1 43	11 24
174	1 45	1 46	1 48	1 52	1 57	2 0	2 1	1 59	1 56	1 51	1 47	1 45	11 36
177	1 47	1 48	1 50	1 54	1 59	2 2	2 3	2 1	1 58	1 53	1 49	1 46	11 48
180	1 49	1 49	1 52	1 56	2 1	2 4	2 5	2 3	2 0	1 55	1 51	1 48	12 0

TABLE 25.

To reduce the Sun's Right Ascension to any given Meridian, and to any Time under that Meridian.

{Add in W. long. Sub. in E. long.} {Add aft. noon. Sub. bef. noon.}

Long.	Sun's Right Ascension.												Time fr.Noon.
	12h	13h	14h	15h	16h	17h	18h	19h	20h	21h	22h	23h	
°	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	h. m.
0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0
3	0 2	0 2	0 2	0 2	0 2	0 2	0 2	0 2	0 2	0 2	0 2	0 2	0 12
6	0 4	0 4	0 4	0 4	0 4	0 4	0 5	0 4	0 4	0 4	0 4	0 4	0 24
9	0 5	0 5	0 6	0 6	0 6	0 7	0 7	0 7	0 6	0 6	0 6	0 6	0 36
12	0 7	0 7	0 8	0 8	0 8	0 9	0 9	0 9	0 8	0 8	0 8	0 7	0 48
15	0 9	0 9	0 10	0 10	0 11	0 11	0 11	0 11	0 11	0 10	0 10	0 9	1 0
18	0 11	0 11	0 11	0 12	0 13	0 13	0 13	0 13	0 13	0 12	0 12	0 11	1 12
21	0 13	0 13	0 13	0 14	0 15	0 15	0 16	0 15	0 15	0 14	0 14	0 13	1 24
24	0 14	0 15	0 15	0 16	0 17	0 17	0 18	0 18	0 17	0 16	0 15	0 15	1 36
27	0 16	0 17	0 17	0 18	0 19	0 20	0 20	0 20	0 19	0 18	0 17	0 17	1 48
30	0 18	0 18	0 19	0 20	0 21	0 22	0 22	0 22	0 21	0 20	0 19	0 19	2 0
33	0 20	0 20	0 21	0 22	0 23	0 24	0 24	0 24	0 23	0 22	0 21	0 21	2 12
36	0 22	0 22	0 23	0 24	0 25	0 26	0 27	0 26	0 25	0 24	0 23	0 23	2 24
39	0 23	0 24	0 25	0 26	0 27	0 28	0 29	0 29	0 28	0 26	0 25	0 24	2 36
42	0 25	0 26	0 27	0 28	0 30	0 31	0 31	0 31	0 30	0 28	0 27	0 26	2 48
45	0 27	0 28	0 29	0 30	0 32	0 33	0 33	0 33	0 32	0 30	0 29	0 28	3 0
48	0 29	0 29	0 31	0 32	0 34	0 35	0 35	0 35	0 34	0 32	0 31	0 30	3 12
51	0 31	0 31	0 33	0 34	0 36	0 37	0 38	0 37	0 36	0 35	0 33	0 32	3 24
54	0 32	0 33	0 34	0 36	0 38	0 39	0 40	0 40	0 38	0 37	0 35	0 34	3 36
57	0 34	0 35	0 36	0 38	0 40	0 42	0 42	0 42	0 40	0 39	0 37	0 36	3 48
60	0 36	0 37	0 38	0 40	0 42	0 44	0 44	0 44	0 43	0 41	0 39	0 37	4 0
63	0 38	0 39	0 40	0 42	0 44	0 46	0 47	0 46	0 45	0 43	0 41	0 39	4 12
66	0 40	0 40	0 42	0 44	0 47	0 48	0 49	0 48	0 47	0 45	0 43	0 41	4 24
69	0 41	0 42	0 44	0 46	0 49	0 50	0 51	0 51	0 49	0 47	0 44	0 43	4 36
72	0 43	0 44	0 46	0 48	0 51	0 53	0 53	0 53	0 51	0 49	0 46	0 45	4 48
75	0 45	0 46	0 48	0 50	0 53	0 55	0 56	0 55	0 53	0 51	0 48	0 47	5 0
78	0 47	0 48	0 50	0 52	0 55	0 57	0 58	0 57	0 55	0 53	0 50	0 49	5 12
81	0 49	0 50	0 52	0 54	0 57	0 59	1 0	0 59	0 58	0 55	0 52	0 51	5 24
84	0 50	0 51	0 54	0 56	0 59	1 1	1 2	1 2	1 0	0 57	0 54	0 52	5 36
87	0 52	0 53	0 56	0 59	1 1	1 4	1 4	1 4	1 2	0 59	0 56	0 54	5 48
90	0 54	0 55	0 58	1 1	1 4	1 6	1 7	1 6	1 4	1 1	0 58	0 56	6 0
93	0 56	0 57	0 59	1 3	1 6	1 8	1 9	1 8	1 6	1 3	1 0	0 58	6 12
96	0 58	0 59	1 1	1 5	1 8	1 10	1 11	1 10	1 8	1 5	1 2	1 0	6 24
99	0 59	1 1	1 3	1 7	1 10	1 12	1 13	1 13	1 10	1 7	1 4	1 2	6 36
102	1 1	1 2	1 5	1 9	1 12	1 15	1 16	1 15	1 12	1 9	1 6	1 4	6 48
105	1 3	1 4	1 7	1 11	1 14	1 17	1 18	1 17	1 14	1 11	1 8	1 6	7 0
108	1 5	1 6	1 9	1 13	1 16	1 19	1 20	1 19	1 17	1 13	1 10	1 7	7 12
111	1 7	1 8	1 11	1 15	1 18	1 21	1 22	1 21	1 19	1 15	1 12	1 9	7 24
114	1 8	1 10	1 13	1 17	1 20	1 23	1 24	1 24	1 21	1 17	1 14	1 11	7 36
117	1 10	1 12	1 15	1 19	1 23	1 25	1 27	1 26	1 23	1 19	1 16	1 13	7 48
120	1 12	1 13	1 17	1 21	1 25	1 28	1 29	1 28	1 25	1 21	1 17	1 15	8 0
123	1 14	1 15	1 19	1 23	1 27	1 30	1 31	1 30	1 27	1 23	1 19	1 17	8 12
126	1 16	1 17	1 21	1 25	1 29	1 32	1 33	1 32	1 29	1 25	1 21	1 19	8 24
129	1 17	1 19	1 22	1 27	1 31	1 34	1 36	1 35	1 32	1 27	1 23	1 21	8 36
132	1 19	1 21	1 24	1 29	1 33	1 36	1 38	1 37	1 34	1 29	1 25	1 22	8 48
135	1 21	1 23	1 26	1 31	1 35	1 39	1 40	1 39	1 36	1 31	1 27	1 24	9 0
138	1 23	1 25	1 28	1 33	1 37	1 41	1 42	1 41	1 38	1 33	1 29	1 26	9 12
141	1 25	1 26	1 30	1 35	1 40	1 43	1 44	1 43	1 40	1 36	1 31	1 28	9 24
144	1 26	1 28	1 32	1 37	1 42	1 45	1 47	1 46	1 42	1 38	1 33	1 30	9 36
147	1 28	1 30	1 34	1 39	1 44	1 47	1 49	1 48	1 44	1 40	1 35	1 32	9 48
150	1 30	1 32	1 36	1 41	1 46	1 50	1 51	1 50	1 46	1 42	1 37	1 34	10 0
153	1 32	1 34	1 38	1 43	1 48	1 52	1 53	1 52	1 49	1 44	1 39	1 36	10 12
156	1 34	1 36	1 40	1 45	1 50	1 54	1 56	1 54	1 51	1 46	1 41	1 38	10 24
159	1 35	1 37	1 42	1 47	1 52	1 56	1 58	1 57	1 53	1 48	1 43	1 39	10 36
162	1 37	1 39	1 44	1 49	1 54	1 58	2 0	1 59	1 55	1 50	1 45	1 41	10 48
165	1 39	1 41	1 46	1 51	1 57	2 1	2 2	2 1	1 57	1 52	1 46	1 43	11 0
168	1 41	1 43	1 47	1 53	1 59	2 3	2 4	2 3	1 59	1 54	1 48	1 45	11 12
171	1 43	1 45	1 49	1 55	2 1	2 5	2 7	2 5	2 1	1 56	1 50	1 47	11 24
174	1 44	1 47	1 51	1 57	2 3	2 7	2 9	2 8	2 4	1 58	1 52	1 49	11 36
177	1 46	1 48	1 53	1 59	2 5	2 9	2 11	2 10	2 6	2 0	1 54	1 51	11 48
180	1 48	1 50	1 55	2 1	2 7	2 12	2 13	2 12	2 8	2 2	1 56	1 52	12 0

TABLE 26.

Parallax of the Planets in Altitude.

App. Alt.	Planet's Horizontal Parallax.																	App. Alt.
	1″	3″	5″	7″	9″	11″	13″	15″	17″	19″	21′	23″	25″	27″	29″	31″	33″	
10°	1	3	5	7	9	11	13	15	17	19	21	23	25	27	29	30	32	10°
20	1	3	5	7	9	10	12	14	16	18	20	22	24	25	27	29	31	20
25	1	3	5	6	8	10	12	14	15	17	19	21	23	24	26	28	30	25
30	1	3	4	6	8	10	11	13	15	16	18	20	22	23	25	27	29	30
33	1	2	4	6	8	9	11	13	14	16	18	19	21	23	24	26	28	33
36	1	2	4	6	7	9	11	12	14	15	17	19	20	22	23	25	27	36
39	1	2	4	5	7	9	10	12	13	15	16	18	19	21	23	24	26	39
42	1	2	4	5	7	8	10	11	13	14	16	17	19	20	22	23	25	42
45	1	2	4	5	6	8	9	11	12	13	15	16	18	19	21	22	23	45
48	1	2	3	5	6	7	9	10	11	13	14	15	17	18	19	21	22	48
51	1	2	3	4	6	7	8	9	11	12	13	14	16	17	18	20	21	51
54	1	2	3	4	5	6	8	9	10	11	12	14	15	16	17	18	19	54
57	1	2	3	4	5	6	7	8	9	10	11	12	14	15	16	17	18	57
60	1	2	3	4	5	5	7	8	9	10	11	12	13	14	15	16	17	60
63	0	1	2	3	4	5	6	7	8	9	10	10	11	12	13	14	15	63
66	0	1	2	3	4	4	5	6	7	8	9	9	10	11	12	13	13	66
69	0	1	2	3	3	4	5	5	6	7	8	8	9	10	10	11	12	69
72	0	1	2	2	3	3	4	5	5	6	6	7	8	8	9	10	10	72
75	0	1	1	2	2	3	3	4	4	5	5	6	6	7	8	8	9	75
78	0	1	1	1	2	2	3	3	4	4	4	5	5	6	6	6	7	78
81	0	0	1	1	1	2	2	2	3	3	3	4	4	4	5	5	5	81
84	0	0	1	1	1	1	1	2	2	2	2	2	3	3	3	3	3	84
87	0	0	0	0	0	1	1	1	1	1	1	1	1	1	2	2	2	87

TABLE 27.

Sun's Mean Right Ascension.

Days	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Days
	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	
1	18 46	20 58	22 48	0 42	2 33	4 35	6 40	8 45	10 41	12 29	14 25	16 29	1
2	18 50	21 2	22 52	0 45	2 37	4 40	6 44	8 49	10 44	12 32	14 29	16 33	2
3	18 54	21 6	22 56	0 49	2 40	4 44	6 48	8 52	10 48	12 36	14 33	16 37	3
4	18 59	21 10	22 59	0 53	2 44	4 48	6 52	8 56	10 52	12 40	14 37	16 42	4
5	19 3	21 14	23 3	0 56	2 48	4 52	6 56	9 0	10 55	12 43	14 41	16 46	5
6	19 8	21 18	23 7	1 0	2 52	4 56	7 0	9 4	10 59	12 47	14 45	16 51	6
7	19 12	21 22	23 10	1 4	2 56	5 0	7 4	9 8	11 2	12 51	14 49	16 55	7
8	19 16	21 26	23 14	1 7	3 0	5 4	7 9	9 12	11 6	12 54	14 53	16 59	8
9	19 21	21 30	23 18	1 11	3 4	5 8	7 13	9 15	11 10	12 58	14 57	17 4	9
10	19 25	21 34	23 21	1 15	3 8	5 13	7 17	9 19	11 13	13 2	15 1	17 8	10
11	19 29	21 38	23 25	1 18	3 11	5 17	7 21	9 23	11 17	13 5	15 5	17 13	11
12	19 34	21 42	23 29	1 22	3 15	5 21	7 25	9 27	11 20	13 9	15 9	17 17	12
13	19 38	21 46	23 33	1 26	3 19	5 25	7 29	9 31	11 24	13 13	15 13	17 21	13
14	19 42	21 50	23 36	1 29	3 23	5 29	7 33	9 34	11 28	13 16	15 17	17 26	14
15	19 47	21 54	23 40	1 33	3 27	5 33	7 37	9 38	11 31	13 20	15 21	17 30	15
16	19 51	21 58	23 43	1 37	3 31	5 37	7 41	9 42	11 35	13 24	15 25	17 35	16
17	19 55	22 2	23 47	1 40	3 35	5 42	7 45	9 46	11 38	13 28	15 30	17 39	17
18	20 0	22 5	23 51	1 44	3 39	5 46	7 49	9 49	11 42	13 31	15 34	17 43	18
19	20 4	22 9	23 54	1 48	3 43	5 50	7 53	9 53	11 46	13 35	15 38	17 48	19
20	20 8	22 13	23 58	1 51	3 47	5 54	7 57	9 57	11 49	13 39	15 42	17 52	20
21	20 12	22 17	0 2	1 55	3 51	5 58	8 1	10 0	11 53	13 43	15 46	17 57	21
22	20 17	22 21	0 5	1 59	3 55	6 2	8 5	10 4	11 56	13 46	15 50	18 1	22
23	20 21	22 25	0 9	2 3	3 59	6 7	8 9	10 8	12 0	13 50	15 55	18 6	23
24	20 25	22 28	0 13	2 6	4 3	6 11	8 13	10 12	12 4	13 54	15 59	18 10	24
25	20 29	22 32	0 16	2 10	4 7	6 15	8 17	10 15	12 7	13 58	16 3	18 15	25
26	20 33	22 36	0 20	2 14	4 11	6 19	8 21	10 19	12 11	14 2	16 7	18 19	26
27	20 37	22 40	0 23	2 18	4 15	6 23	8 25	10 23	12 14	14 6	16 12	18 23	27
28	20 42	22 43	0 27	2 21	4 19	6 27	8 29	10 26	12 18	14 9	16 16	18 28	28
29	20 46	22 46	0 31	2 25	4 23	6 31	8 33	10 30	12 22	14 13	16 20	18 32	29
30	20 50		0 34	2 29	4 27	6 36	8 37	10 33	12 25	14 17	16 25	18 37	30
31	20 54		0 38		4 31		8 41	10 37		14 21		18 41	31

TABLE 28.

Correction for the Altitude of the Pole Star.

R. A. Mer.	Cor. for 1840.	Var. for 10 Yrs.	R. A. Mer.	Cor. for 1840.	Var. for 10 Yrs.	R. A. Mer.	Cor. for 1840.	Var. for 10 Yrs.	R. A. Mer.	Cor. for 1840.	Var. for 10 Yrs.	R. A. Mer.	Cor. for 1840.	Var. for 10 Yrs.
h. m.	° ′	′	h. m.	° ′	′	h. m.	° ′	′	h. m.	° ′	′	h. m.	° ′	′
	sub			*sub*			*add*			*add*			*sub*	
0 0	1 29	—3	6 5	23	—0	9 0	46	—3	16 10	1 3	—1	19 35	13	—1
20	1 31	—3	10	21	—0	10	49	—2	20	1 0	—1	40	15	—1
40	1 32	—3	15	19	—0	20	52	—2	30	57	—1	45	17	—1
1 20	1 32	—3	20	17	—0	30	55	—2	40	53	—1	50	19	—1
40	1 31	—3	25	15	—0	40	59	—3	50	50	—0	55	21	—1
2 0	1 30	—3	30	13	—0	50	1 2	—3	55	49	—1	20 0	23	—2
10	1 28	—3	35	11	+1	10 0	1 5	—3	17 0	47	—1	5	25	—2
20	1 27	—3	40	9	+1	10	1 8	—3	5	45	—0	10	27	—2
30	1 26	—3	45	7	+1	20	1 10	—3	10	43	—0	15	29	—2
40	1 24	—2	6 50	5	+1	30	1 13	—3	20	40	—1	20	31	—2
50	1 22	—2	55	3	+1	40	1 15	—3	25	38	—0	25	33	—3
3 0	1 20	—2	7 0	1	+1	50	1 18	—4	30	36	—0	30	35	—3
10	1 18	—2		*add*		11 0	1 20	—4	35	34	—0	35	37	—3
20	1 16	—2	5	1	—1	10	1 21	—3	40	32	—0	40	38	—2
30	1 14	—2	10	3	—1	20	1 23	—3	45	31	—0	45	40	—2
40	1 11	—2	15	5	—1	30	1 25	—3	50	29	—0	50	42	—2
50	1 9	—2	20	7	—1	40	1 27	—4	55	27	—0	55	44	—3
4 0	1 6	—2	25	9	—1	50	1 28	—3	18 0	25	—0	21 0	46	—3
10	1 3	—1	30	11	—1	12 0	1 29	—3	5	23	—0	10	49	—2
20	1 0	—1	35	13	—1	20	1 31	—3	10	21	—0	20	52	—2
30	57	—1	40	15	—1	40	1 32	—3	15	19	—0	30	55	—2
40	53	—1	45	17	—1	13 20	1 32	—3	20	17	—0	40	59	—3
50	50	—0	50	19	—1	40	1 31	—3	25	15	—0	50	1 2	—3
55	49	—1	55	21	—1	14 0	1 30	—3	30	13	—0	22 0	1 5	—3
5 0	47	—1	8 0	23	—2	10	1 28	- 3	35	11	+1	10	1 8	—3
5	45	—0	5	25	—2	20	1 27	—3	40	9	+1	20	1 10	—3
10	43	—0	10	27	—2	30	1 26	—3	45	7	+1	30	1 13	—3
20	40	—1	15	29	—2	40	1 24	—2	50	5	+1	40	1 15	—3
25	38	—0	20	31	—2	50	1 22	—2	55	3	+1	50	1 18	—4
30	36	—0	25	33	—3	15 0	1 20	—2		*sub*		23 0	1 20	—4
35	34	—0	30	35	—3	10	1 18	—2	19 5	1	—1	20	1 23	—3
40	32	—0	35	37	—3	20	1 16	—2	10	3	—1	30	25	—3
45	31	—0	40	38	—2	30	1 14	—2	15	5	—1	40	27	—4
50	29	—0	45	40	—2	40	1 11	—2	20	7	—1	50	28	—3
55	27	—0	50	42	—2	50	1 9	—2	25	9	—1			
6 0	25	—0	55	44	—3	16 0	1 6	—2	30	11	—1			

TABLE 29.

Corrections of the Latitude deduced from the above Table.

R. A. Mer.	Approximate Latitude.															R. A. Mer.
	0°	10°	20°	30°	35°	40°	45°	50°	55°	60°	65°	70°	75°	80°	85°	
h. m.	″	″	″	″	″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	h. m.
0 58	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0 58
2 0	0	1	2	4	5	5	6	8	9	11	14	18	24	41	1 38	24 0
3 0	0	4	8	12	15	19	22	26	32	39	48	1 3	1 28	2 19	5 32	23 0
4 0	0	7	15	24	30	36	43	51	1 2	1 15	1 34	2 2	2 49	4 27	10 8	22 0
5 0	0	11	23	37	44	53	1 4	1 16	1 31	1 51	2 18	2 59	4 6	6 23	13 49	21 0
6 0	0	13	28	44	54	1 5	1 18	1 33	1 52	2 14	2 48	3 37	4 55	7 40	15 36	20 0
7 0	0	14	29	47	57	1 9	1 22	1 38	1 57	2 21	2 57	3 46	5 7	7 44	15 18	19 0
8 0	0	12	28	44	53	1 4	1 15	1 30	1 48	2 9	2 42	3 26	4 39	6 55	13 11	18 0
9 0	0	10	22	35	42	50	1 0	1 11	1 25	1 41	2 6	2 42	3 36	5 19	9 53	17 0
10 0	0	7	14	23	28	31	1 40	47	56	1 5	1 23	1 45	2 21	3 26	6 13	16 0
11 0	0	4	8	12	14	17	20	24	28	32	42	53	1 9	1 40	2 58	15 0
12 0	0	2	3	4	4	5	6	7	8	9	11	14	19	26	45	14 0
12 30	0	1	2	2	2	2	2	3	3	3	4	4	5	7	11	13 30

TABLE 30.

Log Rising, or Versed Sines.

RISING.

0 Hour.

′	0″	5″	10″	15″	20″	25″	30″	35″	40″	45″	50″	55″	Pro. pts.
0	9·			.	02436	21818	37654	51044	62642	72873	82024	90303	
1	9·97860	04813	11250	17242	22848	28114	33079	37775	42230	46468	50509	54370	
2	0·58066	61612	65019	68297	71455	74503	77448	80296	83054	85726	88319	90837	
3	93284	95664	97980	00236	02435	04580	06673	08717	10714	12666	14575	16443	
4	1·18271	20062	21817	23537	25224	26878	28502	30095	31660	33198	34708	36193	
5	37653	39088	40501	41890	43258	44605	45931	47237	48524	49792	51041	52273	
6	53488	54686	55868	57034	58184	59320	60440	61547	62639	63718	64784	65837	
7	66877	67905	68920	69924	70917	71898	72869	73829	74778	75717	76646	77565	
8	78474	79374	80265	81147	82019	82884	83739	84587	85426	86257	87080	87896	
9	88703	89504	90297	91083	91862	92634	93399	94157	94909	95655	96394	97127	
10	1·97854	98574	99289	99998	00701	01399	02091	02777	03458	04134	04805	05470	5 603
11	2·06131	06786	07437	08082	08723	09359	09991	10618	11240	11859	12472	13082	1 120
12	13687	14288	14885	15477	16066	16651	17232	17809	18382	18951	19517	20079	2 240
13	20638	21192	21744	22292	22836	23377	23915	24449	24980	25508	26033	26554	3 361
14	27073	27588	28100	28609	29116	29619	30120	30617	31112	31604	32093	32579	4 482
15	33063	33544	34023	34498	34972	35442	35910	36376	36839	37299	37758	38213	5 422
16	38667	39118	39567	40013	40457	40899	41339	41776	42211	42644	43075	43504	1 84
17	43930	44355	44777	45198	45616	46033	46447	46859	47270	47678	48085	48490	2 168
18	48893	49294	49693	50090	50486	50879	51271	51661	52050	52436	52821	53205	3 253
19	53586	53966	54344	54721	55096	55469	55841	56211	56580	56947	57313	57676	4 338
20	2·58039	58400	58759	59117	59474	59829	60182	60534	60885	61234	61582	61929	5 326
21	62274	62618	62960	63302	63641	63979	64316	64652	64987	65320	65652	65982	1 65
22	66312	66640	66967	67292	67617	67940	68262	68583	68903	69221	69538	69855	2 130
23	70170	70483	70796	71108	71418	71728	72036	72343	72649	72954	73258	73561	3 196
24	73863	74164	74464	74762	75060	75357	75652	75947	76241	76533	76825	77116	4 261
25	77405	77694	77982	78269	78555	78840	79124	79407	79689	79970	80251	80530	5 265
26	80809	81086	81363	81639	81914	82188	82461	82734	83005	83276	83546	83815	1 53
27	84083	84350	84617	84883	85148	85412	85675	85937	86199	86460	86720	86979	2 106
28	87238	87496	87753	88009	88265	88519	88773	89027	89279	89531	89782	90032	3 159
29	90282	90531	90779	91027	91273	91520	91765	92010	92254	92497	92739	92981	4 212
30	2·93223	93463	93703	93942	94181	94419	94656	94893	95129	95364	95599	95833	5 223
31	96067	96299	96532	96763	96994	97224	97454	97683	97912	98140	98367	98594	1 45
32	98820	99045	99270	99495	99719	99942	00164	00386	00608	00829	01049	01269	2 89
33	3·01488	01707	01925	02143	02360	02576	02792	03008	03222	03437	03651	03864	3 134
34	04077	04289	04501	04712	04922	05133	05342	05551	05760	05968	06176	06383	4 178
35	06590	06796	07001	07207	07411	07616	07819	08023	08225	08428	08629	08831	5 194
36	09032	09232	09432	09632	09831	10029	10227	10425	10622	10819	11015	11211	1 39
37	11406	11601	11796	11990	12184	12377	12570	12762	12954	13146	13337	13527	2 78
38	13718	13908	14097	14286	14475	14663	14850	15038	15225	15411	15597	15783	3 116
39	15969	16154	16338	16522	16706	16889	17072	17255	17437	17619	17800	17982	4 155
40	3·18162	18343	18522	18702	18881	19060	19238	19417	19594	19771	19949	20125	5 171
41	20301	20477	20653	20828	21003	21177	21351	21525	21699	21872	22044	22217	1 34
42	22389	22560	22732	22903	23073	23244	23414	23583	23753	23922	24060	24259	2 68
43	24427	24594	24762	24929	25095	25262	25428	25594	25759	25924	26089	26253	3 103
44	26418	26581	26745	26908	27071	27234	27396	27558	27720	27881	28042	28203	4 137
45	28363	28524	28683	28843	29002	29161	29320	29478	29637	29794	29952	30109	5 153
46	30266	30423	30579	30735	30891	31047	31202	31357	31512	31666	31820	31974	1 31
47	32128	32281	32434	32587	32739	32892	33044	33195	33347	33498	33649	33800	2 61
48	33950	34100	34250	34400	34549	34698	34847	34995	35144	35292	35439	35587	3 92
49	35734	35881	36028	36175	36321	36467	36613	36758	36903	37048	37193	37338	4 122
50	3·37482	37626	37770	37914	38057	38200	38343	38486	38628	38770	38912	39054	5 138
51	39195	39336	39477	39618	39759	39899	40039	40179	40319	40458	40597	40736	1 28
52	40875	41013	41152	41290	41427	41565	41702	41839	41976	42113	42250	42386	2 55
53	42522	42658	42794	42929	43064	43199	43334	43469	43603	43737	43871	44005	3 83
54	44138	44272	44405	44537	44670	44803	44935	45067	45199	45331	45462	45593	4 110
55	45724	45855	45986	46116	46247	46377	46507	46636	46766	46895	47024	47153	5 125
56	47282	47410	47539	47667	47795	47923	48050	48177	48305	48432	48558	48685	1 25
57	48811	48938	49064	49190	49315	49441	49566	49691	49816	49941	50066	50190	2 60
58	50314	50438	50562	50686	50809	50933	51056	51179	51301	51424	51547	51669	3 75
59	51791	51913	52035	52156	52278	52399	52520	52641	52761	52882	53002	53122	4 100

TABLE 30.

Log Rising, or Versed Sines.

RISING.

1 Hour.

′	0″	5″	10″	15″	20″	25″	30″	35″	40″	45″	50″	55″	Pro. pts.
0	3·53243	53362	53482	53602	53721	53840	53959	54078	54197	54315	54434	54552	5 115
1	54670	54788	54905	55023	55140	55258	55375	55492	55608	55725	55841	55958	1 23
2	56074	56190	56306	56421	56537	56652	56767	56882	56997	57112	57226	57341	2 46
3	57455	57569	57683	57797	57910	58024	58137	58250	58363	58476	58589	58702	3 69
4	58814	58926	59038	59150	59262	59374	59486	59597	59708	59819	59930	60041	4 92
5	60152	60262	60373	60483	60593	60703	60813	60923	61032	61143	61251	61360	5 107
6	61469	61578	61686	61795	61903	62012	62120	62228	62336	62443	62551	62659	1 21
7	62766	62873	62980	63087	63194	63301	63407	63513	63620	63726	63832	63938	2 43
8	64043	64149	64254	64360	64465	64570	64675	64780	64885	64989	65094	65198	3 64
9	65302	65406	65510	65614	65717	65821	65924	66028	66131	66234	66337	66440	4 86
10	3·66542	66645	66747	66849	66952	67054	67156	67257	67359	67461	67562	67663	5 99
11	67765	67866	67967	68067	68168	68269	68369	68469	68570	68670	68770	68870	1 20
12	68969	69069	69169	69268	69367	69467	69566	69665	69763	69862	69961	70059	2 40
13	70158	70256	70354	70452	70550	70648	70745	70843	70940	71038	71135	71232	3 60
14	71329	71426	71523	71620	71716	71813	71909	72005	72101	72197	72294	72389	4 80
15	72485	72580	72676	72771	72867	72962	73057	73152	73247	73341	73436	73530	5 92
16	73625	73719	73813	73907	74001	74095	74189	74283	74376	74470	74563	74657	1 17
17	74750	74843	74936	75029	75121	75214	75307	75399	75491	75584	75676	75768	2 37
18	75860	75952	76043	76135	76227	76318	76409	76501	76592	76683	76774	76865	3 55
19	76955	77046	77137	77227	77318	77408	77498	77588	77678	77768	77858	77947	4 73
20	3·78037	78127	78216	78305	78395	78484	78573	78662	78750	78839	78928	79016	5 87
21	79105	79193	79282	79370	79458	79546	79634	79722	79809	79897	79985	80072	1 17
22	80159	80247	80334	80421	80508	80595	80682	80768	80855	80942	81028	81115	2 35
23	81201	81287	81373	81459	81545	81631	81717	81802	81888	81974	82059	82144	3 52
24	82230	82315	82400	82485	82570	82655	82739	82824	82908	82993	83077	83162	4 70
25	83246	83330	83414	83498	83582	83666	83749	83833	83917	84000	84083	84167	5 82
26	84250	84333	84416	84499	84582	84665	84748	84830	84913	84995	85078	85160	1 16
27	85242	85324	85406	85488	85570	85652	85734	85816	85897	85979	86060	86141	2 33
28	86223	86304	86385	86466	86547	86628	86709	86790	86870	86951	87031	87112	3 49
29	87192	87272	87352	87433	87513	87593	87672	87752	87832	87912	87991	88071	4 66
30	3·88150	88229	89309	88388	88467	88546	88625	88704	88783	88862	88940	89019	5 77
31	89097	89176	89254	89333	89411	89489	89567	89645	89723	89801	89879	89956	1 15
32	90034	90112	90189	90267	90344	90421	90498	90576	90653	90730	90807	90884	2 31
33	90960	91037	91114	91190	91267	91343	91420	91496	91572	91648	91724	91800	3 46
34	91876	91952	92028	92104	92179	92255	92331	92406	92482	92557	92632	92707	4 62
35	92782	92858	92933	93007	93082	93157	93232	93306	93381	93456	93530	93605	5 73
36	93679	93753	93827	93901	93975	94049	94123	94197	94271	94345	94418	94492	1 15
37	94566	94639	94712	94786	94859	94932	95005	95078	95152	95224	95297	95370	2 29
38	95443	95515	95588	95661	95733	95806	95878	95950	96023	96095	96167	96239	3 44
39	96311	96383	96455	96527	96599	96670	96742	96813	96885	96956	97028	97099	4 58
40	3·97170	97242	97313	97384	97455	97526	97597	97667	97738	97809	97880	97950	5 70
41	98021	98091	98162	98232	98302	98372	98443	98513	98583	98653	98723	98793	1 14
42	98862	98932	99002	99072	99141	99211	99280	99350	99419	99488	99557	99627	2 28
43	99696	99765	99834	99903	99972	00040	00109	00178	00247	00315	00384	00452	3 42
44	4·00521	00589	00657	00726	00794	00862	00930	00998	01066	01134	01202	01270	4 56
45	01337	01405	01473	01540	01608	01675	01743	01810	01877	01945	02012	02079	5 66
46	02146	02213	02280	02347	02414	02481	02547	02614	02681	02747	02814	02880	1 13
47	02947	03013	03080	03146	03212	03278	03344	03411	03477	03542	03608	03674	2 26
48	03740	03806	03871	03937	04003	04068	04134	04199	04265	04330	04395	04460	3 40
49	04526	04591	04656	04721	04786	04851	04916	04980	05045	05110	05175	05239	4 53
50	4·05304	05368	05433	05497	05561	05626	05690	05754	05818	05882	05946	06010	5 63
51	06074	06138	06202	06266	06330	06393	06457	06521	06584	06648	06711	06775	1 13
52	06838	06901	06965	07028	07091	07154	07217	07280	07343	07406	07469	07532	2 25
53	07595	07657	07720	07783	07845	07908	07970	08033	08095	08157	08220	08282	3 38
54	08344	08406	08468	08530	08592	08654	08716	08778	08840	08902	08964	09025	4 50
55	09087	09148	09210	09272	09333	09394	09456	09517	09578	09640	09701	09762	5 60
56	09823	09884	09945	10006	10067	10128	10188	10249	10310	10371	10431	10492	1 12
57	10552	10613	10673	10734	10794	10854	10915	10975	11035	11095	11155	11215	2 24
58	11275	11335	11395	11455	11515	11575	11634	11694	11754	11813	11873	11932	3 36
59	11992	12051	12111	12170	12229	12289	12348	12407	12466	12525	12584	12643	4 48

TABLE 30.

Log Rising, or Versed Sines.

RISING.

2 Hours.

′	0″	5″	10″	15″	20″	25″	30″	35″	40″	45″	50″	55″	Pro. pts.
0	4·12702	12761	12820	12879	12938	12996	13055	13114	13172	13231	13289	13348	s 57
1	13406	13465	13523	13581	13640	13698	13756	13814	13872	13931	13989	14047	1 11
2	14104	14162	14220	14278	14336	14394	14451	14508	14567	14625	14682	14739	2 23
3	14797	14854	14911	14969	15026	15083	15140	15198	15255	15312	15369	15426	3 34
4	15483	15540	15597	15653	15710	15767	15824	15880	15937	15994	16050	16107	4 46
5	16163	16220	16276	16332	16389	16445	16501	16557	16614	16670	16726	16782	s 55
6	16838	16894	16950	17006	17062	17117	17173	17229	17285	17340	17396	17451	1 11
7	17507	17563	17618	17673	17729	17784	17840	17895	17950	18005	18060	18116	2 22
8	18171	18226	18281	18336	18391	18445	18500	18555	18610	18665	18719	18774	3 33
9	18829	18883	18938	18992	19047	19101	19156	19210	19265	19319	19373	19427	4 44
10	4·19482	19536	19590	19644	19698	19752	19806	19860	19914	19968	20022	20075	s 53
11	20129	20183	20236	20290	20344	20397	20451	20505	20558	20611	20665	20718	1 11
12	20771	20825	20878	20931	20984	21037	21091	21144	21197	21250	21303	21356	2 21
13	21409	21461	21514	21567	21620	21673	21725	21778	21831	21883	21936	21988	3 32
14	22041	22093	22146	22198	22250	22303	22355	22407	22459	22511	22564	22616	4 42
15	22668	22720	22772	22824	22876	22928	22980	23031	23083	23135	23187	23238	s 51
16	23290	23342	23393	23445	23496	23548	23599	23651	23702	23754	23805	23856	1 10
17	23907	23959	24010	24061	24112	24163	24214	24265	24316	24367	24418	24469	2 20
18	24520	24571	24622	24673	24723	24774	24825	24875	24926	24977	25027	25078	3 31
19	25128	25178	25229	25279	25330	25380	25430	25481	25531	25581	25631	25681	4 41
20	4·25731	25781	25831	25881	25931	25981	26031	26081	26131	26181	26231	26281	s 49
21	26330	26380	26429	26479	26529	26578	26628	26677	26727	26776	26826	26875	1 10
22	26924	26974	27023	27072	27121	27171	27220	27269	27318	27367	27416	27465	2 20
23	27514	27563	27612	27661	27710	27759	27807	27856	27905	27954	28002	28051	3 29
24	28099	28148	28197	28245	28294	28342	28391	28439	28487	28536	28584	28632	4 39
25	28681	28729	28777	28825	28873	28921	28969	29017	29066	29114	29161	29209	s 47
26	29257	29305	29353	29401	29449	29496	29544	29592	29639	29687	29735	29782	1 9
27	29830	29877	29925	29973	30020	30067	30115	30162	30209	30257	30304	30351	2 19
28	30398	30445	30493	30540	30587	30634	30681	30728	30775	30822	30869	30916	3 28
29	30963	31009	31056	31103	31150	31197	31243	31290	31337	31383	31430	31476	4 38
30	4·31523	31569	31616	31662	31709	31755	31801	31848	31894	31940	31987	32033	s 45
31	32079	32125	32171	32217	32264	32310	32356	32402	32448	32494	32540	32586	1 9
32	32631	32677	32723	32769	32815	32860	32906	32952	32997	33043	33089	33134	2 18
33	33180	33225	33271	33316	33362	33407	33453	33498	33543	33589	33634	33679	3 27
34	33724	33770	33815	33860	33905	33950	33995	34040	34085	34130	34175	34220	4 36
35	34265	34310	34355	34400	34444	34489	34534	34579	34623	34668	34713	34757	s 44
36	34802	34847	34891	34936	34980	35025	35069	35114	35158	35202	35247	35291	1 9
37	35335	35380	35424	35468	35512	35556	35601	35645	35689	35733	35777	35821	2 18
38	35865	35909	35953	35997	36041	36085	36128	36172	36216	36260	36303	36347	3 27
39	36391	36435	36478	36522	36565	36609	36653	36696	36740	36783	36827	36870	4 35
40	4·36913	36957	37000	37043	37087	37130	37173	37216	37260	37303	37346	37389	s 43
41	37432	37475	37518	37561	37604	37647	37690	37733	37776	37819	37862	37905	1 9
42	37948	37990	38033	38076	38119	38161	38204	38247	38289	38332	38374	38417	2 17
43	38460	38502	38545	38587	38629	38672	38714	38757	38799	38841	38884	38926	3 26
44	38968	39010	39052	39095	39137	39179	39221	39263	39305	39347	39389	39431	4 34
45	39473	39515	39557	39599	39641	39683	39725	39766	39808	39850	39892	39933	s 41
46	39975	40017	40058	40100	40142	40183	40225	40266	40308	40349	40391	40432	1 8
47	40474	40515	40556	40598	40639	40680	40722	40763	40804	40845	40887	40928	2 16
48	40969	41010	41051	41092	41133	41174	41215	41256	41297	41338	41379	41420	3 25
49	41461	41502	41543	41583	41624	41665	41706	41746	41787	41828	41868	41909	4 33
50	4·41950	41990	42031	42071	42112	42153	42193	42233	42274	42314	42355	42395	s 40
51	42435	42476	42516	42556	42597	42637	42677	42717	42758	42798	42838	42878	1 8
52	42918	42958	42998	43038	43078	43118	43158	43198	43238	43278	43318	43358	2 16
53	43398	43437	43477	43517	43557	43597	43636	43676	43716	43755	43795	43835	3 24
54	43874	43914	43953	43993	44032	44072	44111	44151	44190	44229	44269	44308	4 32
55	44348	44387	44426	44465	44505	44544	44583	44622	44662	44701	44740	44779	s 39
56	44818	44857	44896	44935	44974	45013	45052	45091	45130	45169	45208	45247	1 8
57	45286	45325	45363	45402	45441	45480	45518	45557	45596	45634	45673	45712	2 16
58	45750	45789	45827	45866	45905	45943	45982	46020	46058	46097	46135	46174	3 23
59	46212	46250	46289	46327	46365	46404	46442	46480	46518	46556	46595	46633	4 31

TABLE 30.

Log Rising, or Versed Sines.

RISING.

3 Hours.

′	0″	5″	10″	15″	20″	25″	30″	35″	40″	45″	50″	55″	Pro. pts.	
0	4·46671	46709	46747	46785	46823	46861	46899	46937	46975	47013	47051	47089	s	38
1	47127	47165	47203	47241	47278	47316	47354	47392	47430	47467	47505	47543	1	8
2	47580	47618	47656	47693	47731	47768	47806	47843	47881	47918	47956	47993	2	15
3	48031	48068	48106	48143	48180	48218	48255	48292	48330	48367	48404	48441	3	23
4	48479	48516	48553	48590	48627	48664	48701	48739	48776	48813	48850	48887	4	30
5	48924	48961	48998	49035	49071	49108	49145	49182	49219	49256	49293	49329	s	36
6	49366	49403	49440	49476	49513	49550	49586	49623	49660	49696	49733	49769	1	7
7	49806	49842	49879	49915	49952	49988	50025	50061	50098	50134	50170	50207	2	15
8	50243	50279	50316	50352	50388	50424	50461	50497	50533	50569	50605	50641	3	22
9	50677	50714	50750	50786	50822	50858	50894	50930	50966	51002	51038	51073	4	29
10	4·51109	51145	51181	51217	51253	51289	51324	51360	51396	51432	51467	51503	s	35
11	51539	51574	51610	51646	51681	51717	51753	51788	51824	51859	51895	51930	1	7
12	51966	52001	52037	52072	52107	52143	52178	52213	52249	52284	52319	52355	2	14
13	52390	52425	52461	52496	52531	52566	52601	52636	52672	52707	52742	52777	3	21
14	52812	52847	52882	52917	52952	52987	53022	53057	53092	53127	53162	53197	4	28
15	53231	53266	53301	53336	53371	53405	53440	53475	53510	53544	53579	53614	s	34
16	53648	53683	53718	53752	53787	53821	53856	53891	53925	53960	53994	54029	1	7
17	54063	54097	54132	54166	54201	54235	54269	54304	54338	54372	54407	54441	2	14
18	54475	54509	54544	54578	54612	54646	54680	54715	54749	54783	54817	54851	3	20
19	54885	54919	54953	54987	55021	55055	55089	55123	55157	55191	55225	55259	4	26
20	4·55293	55327	55360	55394	55428	55462	55496	55529	55563	55597	55630	55664	s	33
21	55698	55732	55765	55799	55832	55866	55900	55933	55967	56000	56034	56067	1	7
22	56101	56134	56168	56201	56235	56268	56301	56335	56368	56401	56435	56468	2	13
23	56501	56534	56568	56601	56635	56668	56701	56734	56767	56800	56834	56867	3	20
24	56900	56933	56966	56999	57032	57065	57098	57131	57164	57197	57230	57263	4	27
25	57296	57329	57362	57395	57428	57460	57493	57526	57559	57592	57625	57657	s	32
26	57690	57723	57755	57788	57821	57854	57886	57919	57951	57984	58017	58049	1	6
27	58082	58114	58147	58179	58212	58244	58277	58309	58342	58374	58407	58439	2	13
28	58471	58504	58536	58568	58601	58633	58665	58698	58730	58762	58794	58827	3	19
29	58859	58891	58923	58955	58988	59020	59052	59084	59116	59148	59180	59212	4	26
30	4·59244	59276	59308	59340	59372	59404	59436	59468	59500	59532	59564	59596	s	32
31	59627	59659	59691	59723	59755	59786	59818	59850	59882	59913	59945	59977	1	6
32	60008	60040	60072	60103	60135	60167	60198	60230	60261	60293	60324	60356	2	13
33	60388	60419	60450	60482	60513	60545	60576	60608	60639	60670	60701	60733	3	19
34	60764	60796	60827	60858	60890	60921	60952	60983	61015	61046	61077	61108	4	26
35	61139	61171	61202	61233	61264	61295	61326	61357	61388	61419	61450	61481	s	31
36	61512	61543	61574	61605	61636	61667	61698	61729	61760	61791	61822	61852	1	6
37	61883	61914	61945	61976	62006	62037	62068	62099	62129	62160	62191	62222	2	12
38	62252	62283	62313	62344	62375	62405	62436	62466	62497	62528	62558	62589	3	19
39	62619	62650	62680	62711	62741	62771	62802	62832	62863	62893	62923	62954	4	25
40	4·62984	63014	63045	63075	63105	63136	63166	63196	63226	63257	63287	63317	s	30
41	63347	63377	63407	63438	63468	63498	63528	63558	63588	63618	63648	63678	1	6
42	63708	63738	63768	63798	63828	63858	63888	63918	63948	63978	64008	64038	2	12
43	64068	64097	64127	64157	64187	64217	64246	64276	64306	64336	64365	64395	3	18
44	64425	64455	64484	64514	64544	64573	64603	64632	64662	64692	64721	64751	4	24
45	64780	64810	64839	64869	64898	64928	64957	64987	65016	65045	65075	65105	s	29
46	65134	65163	65193	65222	65251	65281	65310	65339	65369	65398	65427	65456	1	6
47	65486	65515	65544	65573	65603	65632	65661	65690	65719	65748	65777	65806	2	12
48	65836	65865	65894	65923	65952	65981	66010	66039	66068	66097	66126	66155	3	17
49	66184	66213	66242	66270	66299	66328	66357	66386	66415	66444	66472	66501	4	23
50	4·66530	66559	66588	66616	66645	66674	66702	66731	66760	66789	66817	66846	s	29
51	66875	66903	66932	66960	66989	67018	67046	67075	67103	67132	67160	67189	1	6
52	67217	67246	67274	67303	67331	67360	67388	67416	67445	67473	67502	67530	2	12
53	67558	67587	67615	67643	67672	67700	67728	67756	67785	67813	67841	67869	3	17
54	67897	67925	67954	67982	68010	68038	68066	68094	68123	68151	68179	68207	4	23
55	68235	68263	68291	68319	68347	68375	68403	68431	68459	68487	68515	68543	s	28
56	68571	68599	68627	68654	68682	68710	68738	68766	68794	68821	68849	68877	1	6
57	68905	68933	68960	68988	69016	69043	69071	69099	69127	69154	69182	69210	2	11
58	69237	69265	69292	69320	69348	69375	69403	69430	69458	69486	69513	69540	3	17
59	69568	69595	69623	69650	69678	69705	69733	69760	69788	69815	69842	69870	4	22

TABLE 30.

Log Rising, or Versed Sines.

RISING.

4 Hours.

′	0″	5″	10″	15″	20″	25″	30″	35″	40″	45″	50″	55″	Pro. pts.
0	4·69897	69924	69952	69979	70006	70034	70061	70088	70115	70143	70170	70197	″ 27
1	70224	70252	70279	70306	70333	70360	70387	70415	70442	70469	70496	70523	1 5
2	70550	70577	70604	70631	70658	70685	70712	70739	70766	70793	70820	70847	2 11
3	70874	70901	70928	70955	70982	71009	71036	71063	71089	71116	71143	71170	3 16
4	71197	71224	71250	71277	71304	71331	71357	71384	71411	71438	71464	71491	4 22
5	71518	71544	71571	71598	71624	71651	71678	71704	71731	71757	71784	71810	″ 26
6	71837	71864	71890	71917	71943	71970	71996	72023	72049	72075	72102	72128	1 5
7	72155	72181	72208	72234	72260	72287	72313	72339	72366	72392	72418	72445	2 11
8	72471	72497	72523	72550	72576	72602	72628	72655	72681	72707	72733	72759	3 16
9	72785	72812	72838	72864	72890	72916	72942	72968	72994	73020	73046	73072	4 21
10	4·73099	73125	73151	73177	73203	73228	73254	73280	73306	73332	73358	73384	″ 26
11	73410	73436	73462	73488	73514	73539	73565	73591	73617	73643	73668	73694	1 5
12	73720	73746	73772	73797	73823	73849	73874	73900	73926	73951	73977	74003	2 10
13	74028	74054	74080	74105	74131	74157	74182	74208	74233	74259	74284	74310	3 16
14	74335	74361	74386	74412	74437	74463	74488	74514	74539	74565	74590	74616	4 21
15	74641	74666	74692	74717	74742	74768	74793	74818	74844	74869	74894	74920	″ 25
16	74945	74970	74995	75021	75046	75071	75096	75122	75147	75172	75197	75222	1 5
17	75247	75273	75298	75323	75348	75373	75398	75423	75448	75473	75498	75523	2 10
18	75549	75574	75599	75624	75649	75674	75699	75723	75748	75773	75798	75823	3 15
19	75848	75873	75898	75923	75948	75973	75997	76022	76047	76072	76097	76121	4 20
20	4·76146	76171	76196	76221	76245	76270	76295	76320	76344	76369	76394	76418	″ 25
21	76443	76468	76492	76517	76542	76566	76591	76615	76640	76665	76689	76714	1 5
22	76738	76763	76787	76812	76836	76861	76885	76910	76934	76959	76983	77008	2 10
23	77032	77057	77081	77105	77130	77154	77179	77203	77227	77252	77276	77300	3 15
24	77325	77349	77373	77398	77422	77446	77470	77495	77519	77543	77567	77592	4 20
25	77616	77640	77664	77688	77713	77737	77761	77785	77809	77833	77857	77882	″ 24
26	77906	77930	77954	77978	78002	78026	78050	78074	78098	78122	78146	78170	1 5
27	78194	78218	78242	78266	78290	78314	78338	78361	78385	78409	78433	78457	2 10
28	78481	78505	78529	78552	78576	78600	78624	78648	78671	78695	78719	78743	3 15
29	78767	78790	78814	78838	78861	78885	78909	78933	78956	78980	79004	79027	4 19
30	4·79051	79074	79098	79122	79145	79169	79192	79216	79240	79263	79287	79310	″ 23
31	79334	79357	79381	79404	79428	79451	79475	79498	79522	79545	79568	79592	1 5
32	79615	79639	79662	79686	79709	79732	79756	79779	79802	79826	79849	79872	2 9
33	79896	79919	79942	79965	79989	80012	80035	80059	80082	80105	80128	80151	3 14
34	80175	80198	80221	80244	80267	80290	80314	80337	80360	80383	80406	80429	4 19
35	80452	80475	80498	80521	80545	80568	80591	80614	80637	80660	80683	80706	″ 23
36	80729	80752	80775	80797	80820	80843	80866	80889	80912	80935	80958	80981	1 5
37	81004	81027	81049	81072	81095	81118	81141	81163	81186	81209	81232	81255	2 9
38	81277	81300	81323	81346	81368	81391	81414	81437	81459	81482	81505	81527	3 14
39	81550	81573	81595	81618	81641	81663	81686	81708	81731	81754	81776	81799	4 18
40	4·81821	81844	81866	81889	81911	81934	81956	81979	82001	82024	82046	82069	″ 22
41	82091	82114	82136	82159	82181	82203	82226	82248	82271	82293	82315	82338	1 4
42	82360	82382	82405	82427	82449	82472	82494	82516	82538	82561	82583	82605	2 9
43	82628	82650	82672	82694	82716	82739	82761	82783	82805	82827	82850	82872	3 13
44	82894	82916	82938	82960	82982	83004	83026	83049	83071	83093	83115	83137	4 19
45	83159	83181	83203	83225	83247	83269	83291	83313	83335	83357	83379	83401	″ 22
46	83423	83445	83467	83488	83510	83532	83554	83576	83598	83620	83642	83663	1 4
47	83685	83707	83729	83751	83773	83794	83816	83838	83860	83881	83903	83925	2 9
48	83947	83968	83990	84012	84034	84055	84077	84099	84120	84142	84164	84185	3 13
49	84207	84229	84250	84272	84293	84315	84337	84358	84380	84401	84423	84444	4 17
50	4 84466	84488	84509	84531	84552	84574	84595	84617	84638	84659	84681	84702	″ 21
51	84724	84745	84767	84788	84810	84831	84852	84874	84895	84916	84938	84959	1 4
52	84981	85002	85023	85044	85066	85087	85108	85130	85151	85172	85194	85215	2 8
53	85236	85257	85278	85300	85321	85342	85363	85385	85406	85427	85448	85469	3 13
54	85490	85512	85533	85554	85575	85596	85617	85638	85659	85680	85701	85722	4 17
55	85744	85765	85786	85807	85828	85849	85870	85891	85912	85933	85954	85975	″ 21
56	85996	86017	86038	86058	86079	86100	86121	86142	86163	86184	86205	86226	1 4
57	86247	86267	86288	86309	86330	86351	86372	86392	86413	86434	86455	86475	2 8
58	86496	86517	86538	86559	86579	86600	86621	86641	86662	86683	86704	86724	3 13
59	86745	86766	86786	86807	86828	86848	86869	86889	86910	86931	86951	86972	4 17

TABLE 30.

Log Rising, or Versed Sines.

RISING.

5 Hours.

′	0″	5″	10″	15″	20″	25″	30″	35″	40″	45″	50″	55″	Pro. pts.
0	4·86992	87013	87034	87054	87075	87095	87116	87136	87157	87177	87198	87218	s 20
1	87239	87259	87280	87300	87321	87341	87362	87382	87402	87423	87443	87464	1 4
2	87484	87505	87525	87545	87566	87586	87606	87627	87647	87667	87688	87708	2 8
3	87728	87749	87769	87789	87809	87830	87850	87870	87890	87911	87931	87951	3 12
4	87971	87992	88012	88032	88052	88072	88093	88113	88133	88153	88173	88193	4 16
5	88213	88234	88254	88274	88294	88314	88334	88354	88374	88394	88414	88434	s 20
6	88454	88474	88494	88514	88534	88554	88574	88594	88614	88634	88654	88674	1 4
7	88694	88714	88734	88754	88774	88794	88814	88834	88853	88873	88893	88913	2 8
8	88933	88953	88973	88992	89012	89032	89052	89072	89091	89111	89131	89151	3 12
9	89171	89190	89210	89230	89250	89269	89289	89309	89328	89348	89368	89388	4 16
10	4·89407	89427	89447	89466	89486	89506	89525	89545	89564	89584	89604	89623	s 19
11	89643	89662	89682	89702	89721	89741	89760	89780	89799	89819	89838	89858	1 4
12	89877	89897	89916	89936	89955	89975	89994	90014	90033	90053	90072	90091	2 8
13	90111	90130	90150	90169	90188	90208	90227	90247	90266	90285	90305	90324	3 12
14	90343	90363	90382	90401	90421	90440	90459	90478	90498	90517	90536	90555	4 16
15	90575	90594	90613	90632	90652	90671	90690	90709	90728	90748	90767	90786	s 19
16	90805	90824	90843	90863	90882	90901	90920	90939	90958	90977	90996	91015	1 4
17	91034	91054	91073	91092	91111	91130	91149	91168	91187	91206	91225	91244	2 8
18	91263	91282	91301	91320	91339	91358	91377	91396	91414	91433	91452	91471	3 11
19	91490	91509	91528	91547	91566	91585	91603	91622	91641	91660	91679	91698	4 15
20	4·91716	91735	91754	91773	91792	91811	91829	91848	91867	91886	91904	91923	s 18
21	91942	91961	91979	91998	92017	92035	92054	92073	92092	92110	92129	92148	1 4
22	92166	92185	92203	92222	92241	92259	92278	92297	92315	92334	92352	92371	2 8
23	92390	92408	92427	92445	92464	92483	92501	92519	92538	92556	92575	92593	3 11
24	92612	92630	92649	92667	92686	92704	92723	92741	92760	92778	92796	92815	4 15
25	92833	92851	92870	92888	92907	92925	92944	92962	92980	92999	93017	93035	s 18
26	93054	93072	93090	93109	93127	93145	93164	93182	93200	93218	93237	93255	1 4
27	93273	93291	93310	93328	93346	93364	93382	93401	93419	93437	93455	93473	2 7
28	93492	93510	93528	93546	93564	93582	93600	93619	93637	93655	93673	93691	3 11
29	93709	93727	93745	93763	93781	93809	93817	93836	93854	93872	93890	93908	4 14
30	4·93926	93944	93962	93980	93998	94016	94034	94052	94069	94088	94105	94123	s 18
31	94141	94159	94177	94195	94213	94231	94249	94267	94284	94302	94320	94338	1 4
32	94356	94374	94392	94410	94427	94445	94463	94481	94498	94516	94534	94552	2 7
33	94570	94587	94605	94623	94641	94658	94676	94694	94711	94729	94747	94765	3 11
34	94782	94800	94818	94835	94853	94871	94888	94906	94924	94941	94959	94976	4 14
35	94994	95012	95029	95047	95065	95082	95100	95117	95135	95153	95170	95188	s 17
36	95205	95223	95240	95258	95275	95293	95310	95328	95345	95363	95380	95398	1 3
37	95415	95433	95450	95468	95485	95502	95520	95537	95555	95572	95589	95607	2 7
38	95624	95642	95659	95676	95694	95711	95728	95746	95763	95780	95798	95815	3 10
39	95832	95850	95867	95884	95902	95919	95936	95953	95971	95988	96005	96022	4 15
40	4·96040	96057	96074	96091	96109	96126	96143	96160	96177	96195	96212	96220	s 17
41	96246	96263	96280	96297	96315	96332	96349	96366	96383	96400	96417	96434	1 3
42	96451	96469	96486	96503	96520	96537	96554	96571	96588	96605	96622	96639	2 7
43	96656	96673	96690	96707	96724	96741	96758	96775	96792	96809	96826	96843	3 10
44	96860	96877	96894	96910	96927	96944	96961	96978	96995	97012	97029	97046	4 14
45	97062	97079	97096	97113	97130	97147	97163	97180	97197	97214	97231	97247	s 17
46	97264	97281	97298	97315	97331	97348	97365	97382	97398	97415	97432	97449	1 3
47	97465	97482	97499	97515	97532	97549	97565	97582	97599	97615	97632	97649	2 7
48	97665	97682	97699	97715	97732	97749	97765	97782	97798	97815	97832	97848	3 10
49	97865	97881	97898	97914	97931	97947	97964	97981	97997	98014	98030	98047	4 13
50	4·98063	98080	98096	98113	98129	98145	98162	98178	98195	98211	98228	98244	s 16
51	98261	98277	98293	98310	98326	98343	98359	98375	98392	98408	98425	98441	1 3
52	98457	98474	98490	98506	98523	98539	98555	98572	98588	98604	98620	98637	2 7
53	98653	98669	98686	98702	98718	98734	98751	98767	98783	98799	98816	98832	3 10
54	98848	98864	98880	98897	98913	98929	98945	98961	98977	98994	99010	99026	4 13
55	99042	99058	99074	99090	99107	99123	99139	99155	99171	99187	99203	99219	s 16
56	99235	99251	99267	99284	99300	99316	99332	99348	99364	99380	99396	99312	1 3
57	99428	99444	99460	99476	99492	99508	99524	99540	99556	99572	99587	99603	2 6
58	99619	99635	99651	99667	99683	99699	99715	99731	99747	99763	99778	99794	3 10
59	99810	99826	99842	99858	99873	99889	99905	99921	99937	99953	99968	99984	4 13

TABLE 30.

Log Rising, or Versed Sines.

RISING.

6 Hours.

′	0″	5″	10″	15″	20″	25″	30″	35″	40″	45″	50″	55″	Pro. pts.
0	5·00000	00016	00032	00047	00063	00079	00095	00110	00126	00142	00158	00173	s 16
1	00189	00205	00221	00236	00252	00268	00283	00299	00315	00330	00346	00362	1 3
2	00377	00393	00409	00424	00440	00456	00471	00487	00502	00518	00534	00549	2 6
3	00565	00580	00596	00612	00627	00643	00658	00674	00689	00705	00720	00736	3 9
4	00751	00767	00782	00798	00813	00829	00844	00860	00875	00891	00906	00922	4 13
5	00937	00953	00968	00984	00999	01014	01030	01045	01061	01076	01091	01107	s 15
6	01122	01138	01153	01168	01184	01199	01214	01230	01245	01260	01276	01291	1 3
7	01306	01322	01337	01352	01368	01383	01398	01413	01429	01444	01459	01474	2 6
8	01490	01505	01520	01536	01551	01566	01581	01596	01612	01627	01642	01657	3 9
9	01672	01688	01703	01718	01733	01748	01763	01779	01794	01809	01824	01839	4 12
10	5·01854	01869	01884	01900	01915	01930	01945	01960	01975	01990	02005	02020	s 15
11	02035	02050	02065	02080	02095	02110	02125	02140	02155	02170	02185	02200	1 3
12	02215	02230	02245	02260	02275	02290	02305	02320	02335	02350	02365	02380	2 6
13	02395	02410	02425	02440	02455	02469	02484	02499	02514	02529	02544	02559	3 9
14	02574	02588	02603	02618	02633	02648	02663	02677	02692	02707	02722	02737	4 12
15	02751	02766	02781	02796	02811	02825	02840	02855	02870	02884	02899	02914	s 15
16	02928	02943	02958	02973	02987	03002	03017	03031	03046	03061	03075	03090	1 3
17	03105	03119	03134	03149	03163	03178	03193	03207	03222	03237	03251	03266	2 6
18	03280	03295	03310	03324	03339	03353	03368	03382	03397	03412	03426	03441	3 9
19	03455	03470	03484	03499	03513	03528	03542	03557	03571	03586	03600	03615	4 12
20	5·03629	03644	03658	03672	03687	03701	03716	03730	03745	03759	03774	03788	s 14
21	03802	03817	03831	03846	03860	03874	03889	03903	03918	03932	03946	03961	1 3
22	03975	03989	04004	04018	04032	04047	04061	04075	04090	04104	04118	04132	2 6
23	04147	04161	04175	04190	04204	04218	04232	04247	04261	04275	04289	04303	3 9
24	04318	04332	04346	04360	04375	04389	04403	04417	04431	04445	04460	04474	4 12
25	04488	04502	04516	04530	04545	04559	04573	04587	04601	04615	04629	04643	s 14
26	04657	04672	04686	04700	04714	04728	04742	04756	04770	04784	04798	04812	1 3
27	04826	04840	04854	04868	04882	04896	04910	04924	04938	04952	04966	04980	2 6
28	04994	05008	05022	05036	05050	05064	05078	05092	05106	05120	05134	05148	3 9
29	05162	05175	05189	05203	05217	05231	05245	05259	05273	05286	05300	05314	4 11
30	5·05328	05342	05356	05370	05383	05397	05411	05425	05439	05452	05466	05480	s 14
31	05494	05508	05521	05535	05549	05563	05577	05590	05604	05618	05632	05645	1 3
32	05659	05673	05686	05700	05714	05728	05741	05755	05769	05782	05796	05810	2 5
33	05823	05837	05851	05864	05878	05892	05905	05919	05933	05946	05960	05973	3 8
34	05987	06001	06014	06028	06041	06055	06069	06082	06096	06109	06123	06136	4 11
35	06150	06163	06177	06191	06204	06218	06231	06245	06258	06272	06285	06299	s 13
36	06312	06326	06339	06353	06366	06379	06393	06406	06420	06433	06447	06460	1 3
37	06474	06487	06500	06514	06527	06541	06554	06567	06581	06594	06608	06621	2 5
38	06634	06648	06661	06674	06688	06701	06714	06728	06741	06754	06768	06781	3 8
39	06794	06808	06821	06834	06848	06861	06874	06887	06901	06914	06927	06941	4 11
40	5·06954	06967	06980	06994	07007	07020	07033	07046	07060	07073	07086	07099	s 13
41	07112	07126	07139	07152	07165	07178	07192	07205	07218	07231	07244	07257	1 3
42	07270	07284	07297	07310	07323	07336	07349	07362	07375	07388	07401	07415	2 5
43	07428	07441	07454	07467	07480	07493	07506	07519	07532	07545	07558	07571	3 8
44	07584	07597	07610	07623	07636	07649	07662	07675	07688	07701	07714	07727	4 10
45	07740	07753	07766	07779	07792	07805	07818	07831	07844	07857	07869	07882	s 13
46	07895	07908	07921	07934	07947	07960	07973	07985	07998	08011	08024	08037	1 3
47	08050	08063	08075	08088	08101	08114	08127	08140	08152	08165	08178	08191	2 5
48	08204	08216	08229	08242	08255	08267	08240	08293	08306	08318	08331	08344	3 8
49	08357	08369	08382	08395	08408	08420	08433	08446	08458	08471	08484	08496	4 10
50	5·08509	08522	08534	08547	08560	08572	08585	08598	08610	08623	08636	08648	s 13
51	08661	08673	08686	08699	08711	08724	08736	08749	08762	08774	08787	08799	1 3
52	08812	08824	08837	08850	08862	08875	08887	08900	08912	08925	08937	08950	2 5
53	08962	08975	08987	09000	09012	09025	09037	09050	09062	09075	09087	09100	3 8
54	09112	09124	09137	09149	09162	09174	09187	09199	09211	09224	09236	09249	4 10
55	09261	09273	09286	09298	09311	09323	09335	09348	09360	09372	09385	09397	s 12
56	09409	09422	09434	09446	09459	09471	09483	09496	09508	09520	09533	09545	1 2
57	09557	09569	09582	09594	09606	09618	09631	09643	09655	09667	09680	09692	2 5
58	09704	09716	09729	09741	09753	09765	09777	09790	09802	09814	09826	09838	3 7
59	09851	09863	09875	09887	09899	09911	09924	09936	09948	09960	09972	09984	4 10

TABLE 30.

Log Rising, or Versed Sines.

RISING.

7 Hours.

′	0″	5″	10″	15″	20″	25″	30″	35″	40″	45″	50″	55″	Pro. pts.
0	5.09996	10008	10021	10033	10045	10057	10069	10081	10093	10105	10117	10129	s 12
1	10141	10153	10166	10178	10190	10202	10214	10226	10238	10250	10262	10274	1 2
2	10286	10298	10310	10322	10334	10346	10358	10370	10382	10394	10406	10418	2 5
3	10430	10441	10454	10465	10477	10489	10501	10513	10525	10537	10549	10561	3 7
4	10573	10585	10597	10608	10620	10632	10644	10656	10668	10680	10691	10703	4 10
5	10715	10727	10739	10751	10763	10774	10786	10798	10810	10822	10833	10845	s 12
6	10857	10869	10881	10893	10904	10916	10928	10940	10951	10963	10975	10986	1 2
7	10998	11010	11022	11033	11045	11057	11069	11080	11092	11104	11115	11127	2 5
8	11139	11150	11162	11174	11185	11197	11209	11220	11232	11244	11255	11267	3 7
9	11279	11290	11302	11314	11325	11337	11348	11360	11372	11383	11395	11406	4 10
10	5.11418	11429	11441	11453	11464	11476	11487	11499	11510	11522	11533	11545	s 12
11	11557	11568	11580	11591	11603	11614	11626	11637	11649	11660	11672	11683	1 2
12	11695	11706	11717	11729	11740	11752	11763	11775	11786	11798	11809	11820	2 5
13	11832	11843	11855	11866	11878	11889	11900	11912	11923	11934	11946	11957	3 7
14	11969	11980	11991	12003	12014	12025	12037	12048	12059	12071	12082	12093	4 9
15	12105	12116	12127	12139	12150	12161	12173	12184	12195	12206	12218	12229	s 11
16	12240	12251	12263	12274	12285	12296	12308	12319	12330	12341	12353	12364	1 2
17	12375	12386	12397	12409	12420	12431	12442	12453	12465	12476	12487	12498	2 5
18	12509	12520	12532	12543	12554	12565	12576	12587	12598	12610	12621	12632	3 7
19	12643	12654	12665	12676	12687	12698	12709	12721	12732	12743	12754	12765	4 9
20	5.12776	12787	12798	12809	12820	12831	12842	12853	12864	12875	12886	12897	s 11
21	12908	12919	12930	12941	12952	12963	12974	12985	12996	13007	13018	13029	1 2
22	13040	13051	13062	13073	13084	13095	13106	13117	13128	13139	13149	13160	2 4
23	13171	13182	13193	13204	13215	13226	13237	13248	13258	13269	13280	13291	3 7
24	13302	13313	13323	13334	13345	13356	13367	13378	13388	13399	13410	13421	4 9
25	13432	13442	13453	13464	13475	13486	13496	13507	13518	13529	13539	13550	s 11
26	13561	13572	13582	13593	13604	13615	13625	13636	13647	13658	13668	13679	1 2
27	13690	13700	13711	13722	13732	13743	13754	13765	13775	13786	13797	13807	2 4
28	13818	13828	13839	13850	13860	13871	13882	13892	13903	13914	13924	13935	3 7
29	13945	13956	13967	13977	13988	13998	14009	14019	14030	14041	14051	14062	4 9
30	5.14072	14083	14093	14104	14114	14125	14136	14146	14157	14167	14178	14188	s 11
31	14199	14209	14220	14230	14241	14251	14262	14272	14282	14293	14303	14314	1 2
32	14324	14335	14345	14356	14366	14377	14387	14397	14408	14418	14429	14439	2 4
33	14449	14460	14470	14481	14491	14501	14512	14522	14533	14543	14553	14564	3 6
34	14574	14584	14595	14605	14615	14626	14636	14646	14657	14667	14677	14688	4 9
35	14698	14708	14719	14729	14739	14750	14760	14770	14780	14790	14801	14811	s 10
36	14821	14832	14842	14852	14862	14872	14883	14893	14903	14913	14924	14934	1 2
37	14944	14954	14964	14975	14985	14995	15005	15015	15026	15036	15046	15056	2 4
38	15066	15076	15087	15097	15107	15117	15127	15137	15147	15157	15168	15178	3 6
39	15188	15198	15208	15218	15228	15238	15248	15258	15269	15279	15289	15299	4 8
40	5.15309	15319	15329	15339	15349	15359	15369	15379	15389	15399	15409	15419	s 10
41	15429	15439	15449	15459	15469	15479	15489	15499	15509	15519	15529	15539	1 2
42	15549	15559	15569	15579	15589	15599	15609	15619	15629	15639	15649	15659	2 4
43	15668	15678	15688	15698	15708	15718	15728	15738	15748	15758	15767	15777	3 6
44	15787	15797	15807	15817	15827	15837	15846	15856	15866	15876	15886	15896	4 8
45	15905	15915	15925	15935	15944	15954	15964	15974	15984	15993	16003	16013	s 10
46	16023	16033	16042	16052	16062	16072	16081	16091	16101	16111	16120	16130	1 2
47	16140	16149	16159	16169	16179	16188	16198	16208	16217	16227	16237	16246	2 4
48	16256	16266	16276	16285	16295	16304	16314	16324	16333	16343	16353	16362	3 6
49	16372	16382	16391	16401	16410	16420	16430	16439	16449	16459	16468	16478	4 8
50	5.16487	16497	16506	16516	16526	16535	16545	16554	16564	16573	16583	16592	s 10
51	16602	16612	16621	16631	16640	16650	16659	16669	16678	16688	16697	16707	1 2
52	16716	16726	16735	16745	16754	16764	16773	16782	16792	16801	16811	16820	2 4
53	16830	16839	16849	16858	16867	16877	16886	16896	16905	16915	16924	16933	3 6
54	16943	16952	16961	16971	16980	16990	16999	17008	17018	17027	17036	17046	4 8
55	17055	17065	17074	17083	17093	17102	17111	17121	17130	17139	17148	17158	s 9
56	17167	17176	17186	17195	17204	17214	17223	17232	17241	17251	17260	17269	1 2
57	17278	17288	17297	17306	17315	17325	17334	17343	17352	17362	17371	17380	2 4
58	17389	17398	17408	17417	17426	17435	17444	17454	17463	17472	17481	17490	3 6
59	17499	17509	17518	17527	17536	17545	17554	17563	17573	17582	17591	17600	4 8

TABLE 31.

To reduce the Sun's Declination to Noon at any given Meridian, and to any Time at the Meridian of Greenwich.

When Sun's dec. is increasing.	add in W. lon. sub in E. lon.	Add for Greenw. time.	When Sun's dec. is decreasing.	sub. in W. lon. add in E. lon.	Sub. for Greenw. time.

Long.	Sun's Declination.												Time fr. Noon.
	0°	2°	4°	6°	8°	9°	10°	11°	12°	13°	14°	15°	
°	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	h. m.
0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0
3	0 12	0 12	0 12	0 11	0 11	0 11	0 11	0 11	0 10	0 10	0 9	0 9	0 12
6	0 24	0 24	0 24	0 23	0 23	0 22	0 22	0 21	0 20	0 20	0 18	0 18	0 24
9	0 35	0 35	0 35	0 34	0 34	0 33	0 32	0 32	0 31	0 30	0 28	0 27	0 36
12	0 47	0 47	0 47	0 46	0 45	0 44	0 43	0 42	0 41	0 40	0 38	0 37	0 48
15	0 59	0 59	0 58	0 57	0 56	0 55	0 54	0 53	0 51	0 50	0 48	0 46	1 0
18	1 11	1 10	1 10	1 9	1 7	1 6	1 5	1 3	1 1	1 0	0 58	0 55	1 12
21	1 22	1 22	1 22	1 21	1 18	1 17	1 16	1 14	1 12	1 9	1 7	1 5	1 24
24	1 34	1 34	1 33	1 32	1 29	1 28	1 27	1 24	1 22	1 19	1 17	1 14	1 36
27	1 46	1 45	1 44	1 43	1 41	1 39	1 38	1 35	1 32	1 29	1 27	1 23	1 48
30	1 58	1 57	1 56	1 54	1 51	1 49	1 48	1 45	1 43	1 39	1 36	1 32	2 0
33	2 10	2 10	2 8	2 6	2 3	2 1	1 59	1 55	1 53	1 49	1 46	1 42	2 12
36	2 22	2 21	2 19	2 17	2 14	2 12	2 10	2 6	2 3	1 59	1 56	1 51	2 24
39	2 33	2 32	2 31	2 29	2 25	2 23	2 20	2 16	2 14	2 9	2 5	2 1	2 36
42	2 45	2 44	2 43	2 40	2 36	2 34	2 31	2 27	2 24	2 19	2 15	2 10	2 48
45	2 57	2 56	2 54	2 51	2 47	2 44	2 41	2 38	2 34	2 29	2 24	2 19	3 0
48	3 9	3 8	3 6	3 3	2 59	2 55	2 52	2 49	2 44	2 39	2 34	2 28	3 12
51	3 20	3 19	3 18	3 15	3 10	3 6	3 3	3 0	2 55	2 49	2 44	2 38	3 24
54	3 32	3 31	3 30	3 26	3 21	3 17	3 14	3 10	3 5	2 59	2 53	2 47	3 36
57	3 43	3 42	3 41	3 37	3 32	3 28	3 25	3 21	3 15	3 9	3 3	2 56	3 48
60	3 55	3 54	3 52	3 48	3 43	3 39	3 35	3 31	3 25	3 19	3 13	3 5	4 0
63	4 7	4 6	4 4	4 0	3 54	3 50	3 46	3 42	3 35	3 29	3 22	3 14	4 12
66	4 19	4 18	4 16	4 12	4 5	4 1	3 57	3 52	3 46	3 39	3 32	3 23	4 24
69	4 31	4 30	4 27	4 23	4 16	4 12	4 8	4 3	3 56	3 49	3 42	3 32	4 36
72	4 43	4 42	4 39	4 34	4 27	4 23	4 19	4 13	4 6	3 59	3 51	3 41	4 48
75	4 54	4 53	4 50	4 45	4 38	4 34	4 29	4 23	4 16	4 9	4 1	3 51	5 0
78	5 6	5 5	5 2	4 57	4 50	4 45	4 40	4 34	4 27	4 19	4 11	4 0	5 12
81	5 18	5 17	5 14	5 9	5 1	4 56	4 51	4 44	4 37	4 29	4 20	4 9	5 24
84	5 30	5 28	5 26	5 20	5 12	5 7	5 2	4 55	4 47	4 39	4 30	4 18	5 36
87	5 41	5 40	5 37	5 31	5 23	5 18	5 13	5 5	4 58	4 49	4 40	4 27	5 48
90	5 53	5 52	5 48	5 42	5 34	5 29	5 23	5 16	5 8	4 59	4 49	4 37	6 0
93	6 5	6 4	6 0	5 54	5 46	5 41	5 34	5 27	5 18	5 9	4 59	4 46	6 12
96	6 17	6 15	6 12	6 6	5 57	5 52	5 45	5 37	5 28	5 19	5 9	4 55	6 24
99	6 28	6 27	6 23	6 17	6 8	6 3	5 56	5 48	5 39	5 29	5 18	5 5	6 36
102	6 40	6 39	6 35	6 28	6 19	6 14	6 7	5 58	5 49	5 39	5 28	5 14	6 48
105	6 52	6 51	6 46	6 39	6 30	6 24	6 17	6 9	5 59	5 49	5 37	5 23	7 0
108	7 4	7 2	6 58	6 51	6 41	6 35	6 28	6 19	6 9	5 59	5 47	5 32	7 12
111	7 15	7 14	7 10	7 3	6 52	6 46	6 39	6 30	6 20	6 9	5 56	5 42	7 24
114	7 27	7 26	7 22	7 15	7 3	6 57	6 50	6 40	6 30	6 19	6 6	5 51	7 36
117	7 39	7 37	7 33	7 26	7 14	7 8	7 1	6 51	6 40	6 29	6 15	6 1	7 48
120	7 51	7 49	7 44	7 37	7 25	7 18	7 11	7 1	6 51	6 39	6 25	6 10	8 0
123	8 3	8 1	7 56	7 49	7 37	7 29	7 22	7 12	7 1	6 49	6 35	6 19	8 12
126	8 14	8 13	8 8	8 0	7 48	7 40	7 33	7 22	7 11	6 59	6 44	6 28	8 24
129	8 26	8 24	8 20	8 11	7 59	7 51	7 43	7 33	7 22	7 9	6 54	6 37	8 36
132	8 38	8 36	8 31	8 22	8 10	8 2	7 54	7 43	7 32	7 18	7 4	6 46	8 48
135	8 50	8 48	8 42	8 33	8 21	8 13	8 4	7 54	7 42	7 28	7 13	6 56	9 0
138	9 1	8 59	8 54	8 45	8 33	8 24	8 15	8 5	7 52	7 38	7 23	7 5	9 12
141	9 13	9 11	9 6	8 57	8 44	8 35	8 26	8 15	8 3	7 48	7 33	7 14	9 24
144	9 25	9 23	9 18	9 8	8 55	8 46	8 37	8 26	8 13	7 58	7 42	7 23	9 36
147	9 37	9 35	9 29	9 19	9 6	8 57	8 48	8 36	8 23	8 8	7 52	7 32	9 48
150	9 48	9 45	9 40	9 30	9 17	9 8	8 58	8 47	8 33	8 18	8 2	7 42	10 0
153	10 0	9 57	9 52	9 42	9 28	9 19	9 9	8 57	8 43	8 28	8 12	7 51	10 12
156	10 12	10 9	10 4	9 54	9 39	9 30	9 20	9 8	8 54	8 38	8 21	8 0	10 24
159	10 24	10 21	10 16	10 5	9 50	9 41	9 31	9 18	9 4	8 48	8 31	8 10	10 36
162	10 36	10 33	10 27	10 16	10 1	9 52	9 42	9 29	9 14	8 58	8 41	8 19	10 48
165	10 47	10 44	10 38	10 27	10 12	10 3	9 52	9 39	9 24	9 8	8 50	8 28	11 0
168	10 59	10 56	10 50	10 39	10 24	10 14	10 3	9 50	9 35	9 18	9 0	8 38	11 12
171	11 11	11 8	11 2	10 51	10 35	10 25	10 14	10 0	9 45	9 28	9 10	8 47	11 24
174	11 23	11 20	11 14	11 3	10 46	10 36	10 25	10 11	9 55	9 38	9 19	8 57	11 36
177	11 34	11 31	11 25	11 14	10 57	10 47	10 36	10 21	10 6	3 48	9 29	9 6	11 48
180	11 46	11 43	11 37	11 25	11 8	10 58	10 46	10 32	10 16	9 58	9 38	9 15	12 0

TABLE 31.

For reducing the Sun's Declination to Noon at any given Meridian, and to any Time at the Meridian of Greenwich.

When Sun's dec. is increasing. { add in W. lon. / sub. in E. lon. } Add for Greenw. time. ‖ When Sun's dec. is decreasing. { sub. in W. lon. / add in E. lon. } Sub. for Greenw. time.

Lon.	Sun's Declination. 16°	17°	18°	19°	19°30′	20°	20°30′	21°	21°30′	22°	22°30′	23°	23°15′	23°28′	Time fr Noon
°	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″
0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0
3	0 9	0 8	0 8	0 7	0 7	0 6	0 6	0 5	0 5	0 4	0 3	0 2	0 2	0 0	0 12
6	0 18	0 16	0 16	0 14	0 13	0 12	0 11	0 10	0 9	0 8	0 6	0 4	0 4	0 0	0 24
9	0 27	0 24	0 24	0 21	0 20	0 18	0 17	0 15	0 14	0 12	0 10	0 7	0 5	0 0	0 36
12	0 36	0 32	0 31	0 28	0 27	0 25	0 23	0 21	0 19	0 16	0 14	0 9	0 7	0 0	0 48
15	0 44	0 41	0 39	0 35	0 34	0 32	0 29	0 27	0 24	0 21	0 18	0 12	0 9	0 0	1 0
18	0 53	0 49	0 46	0 42	0 40	0 38	0 35	0 32	0 29	0 25	0 21	0 14	0 10	6 0	1 12
21	1 2	0 57	0 54	0 49	0 47	0 44	0 41	0 38	0 34	0 29	0 24	0 17	0 12	0 0	1 24
24	1 11	1 5	1 2	0 56	0 54	0 50	0 47	0 44	0 39	0 34	0 28	0 19	0 14	0 0	1 36
27	1 20	1 14	1 10	1 3	1 1	0 57	0 53	0 50	0 44	0 39	0 32	0 22	0 15	0 0	1 48
30	1 28	1 23	1 18	1 11	1 8	1 4	0 59	0 55	0 49	0 43	0 36	0 25	0 17	0 0	2 0
33	1 37	1 31	1 25	1 18	1 14	1 10	1 4	1 0	0 53	0 47	0 39	0 27	0 19	0 0	2 12
36	1 46	1 39	1 33	1 25	1 21	1 16	1 10	1 5	0 58	0 51	0 42	0 30	0 20	0 0	2 24
39	1 55	1 47	1 41	1 32	1 28	1 22	1 16	1 10	1 3	0 55	0 46	0 32	0 22	0 0	2 36
42	2 4	1 56	1 49	1 39	1 35	1 29	1 22	1 16	1 8	0 59	0 50	0 34	0 24	0 0	2 48
45	2 12	2 5	1 57	1 46	1 42	1 36	1 28	1 22	1 13	1 4	0 54	0 36	0 25	0 0	3 0
48	2 21	2 13	2 4	1 53	1 48	1 42	1 33	1 27	1 18	1 8	0 57	0 39	0 27	0 0	3 12
51	2 30	2 21	2 12	2 0	1 55	1 48	1 39	1 32	1 23	1 12	1 0	0 42	0 29	0 0	3 24
54	2 39	2 29	2 20	2 7	2 2	1 54	1 45	1 38	1 28	1 16	1 3	0 44	0 30	0 0	3 36
57	2 48	2 38	2 28	2 15	2 9	2 1	1 52	1 44	1 33	1 21	1 7	0 47	0 32	0 0	3 48
60	2 56	2 47	2 36	2 23	2 16	2 8	1 59	1 49	1 39	1 26	1 11	0 49	0 34	0 0	4 0
63	3 5	2 55	2 43	2 29	2 22	2 14	2 4	1 54	1 43	1 30	1 14	0 51	0 35	0 0	4 12
66	3 14	3 3	2 51	2 36	2 29	2 20	2 10	1 59	1 48	1 34	1 17	0 54	0 37	0 0	4 24
69	3 23	3 11	2 59	2 43	2 36	2 26	2 16	2 4	1 53	1 38	1 21	0 56	0 39	0 0	4 36
72	3 32	3 19	3 7	2 50	2 43	2 33	2 21	2 10	1 58	1 42	1 25	0 59	0 40	0 0	4 48
75	3 40	3 28	3 15	2 58	2 50	2 40	2 27	2 16	2 3	1 47	1 29	1 1	0 42	0 0	5 0
78	3 49	3 36	3 22	3 5	2 56	2 46	2 33	2 21	2 8	1 51	1 32	1 4	0 44	0 0	5 12
81	3 58	3 44	3 30	3 12	3 3	2 52	2 39	2 26	2 13	1 55	1 35	1 6	0 45	0 0	5 24
84	4 7	3 52	3 38	3 19	3 10	2 58	2 45	2 32	2 18	1 59	1 39	1 9	0 47	0 0	5 36
87	4 16	4 1	3 46	3 26	3 17	3 5	2 52	2 38	2 23	2 4	1 43	1 11	0 49	0 0	5 48
90	4 25	4 10	3 54	3 34	3 24	3 12	2 59	2 44	2 28	2 9	1 47	1 14	0 50	0 0	6 0
93	4 34	4 18	4 1	3 41	3 30	3 18	3 4	2 49	2 32	2 [illegible]	1 50	1 16	0 52	0 0	6 12
96	4 43	4 26	4 9	3 48	3 37	3 24	3 9	2 54	2 37	2 17	1 53	1 [illegible]	0 54	0 0	6 24
99	4 52	4 34	4 17	3 55	3 44	3 30	3 15	2 59	2 42	2 21	1 57	1 21	0 55	0 0	6 36
102	5 0	4 43	4 25	4 2	3 51	3 37	3 21	3 5	2 47	2 25	2 1	1 24	0 57	0 0	6 48
105	5 8	4 52	4 33	4 9	3 58	3 44	3 27	3 11	2 52	2 30	2 5	1 26	0 59	0 0	7 0
108	5 17	5 0	4 40	4 16	4 4	3 50	3 33	3 16	2 57	2 34	2 9	1 29	1 0	0 0	7 12
111	5 26	5 8	4 48	4 23	4 11	3 56	3 39	3 21	3 2	2 38	2 12	1 31	1 2	0 0	7 24
114	5 35	5 16	4 56	4 30	4 18	4 2	3 46	3 27	3 7	2 43	2 16	1 34	1 4	0 0	7 36
117	5 44	5 25	5 4	4 38	4 25	4 9	3 52	3 33	3 12	2 48	2 20	1 37	1 5	0 0	7 48
120	5 53	5 34	5 12	4 46	4 32	4 16	3 59	3 39	3 17	2 53	2 23	1 39	1 7	0 0	8 0
123	6 2	5 42	5 19	4 53	4 38	4 22	4 4	3 44	3 22	2 57	2 26	1 41	1 9	0 0	8 12
126	6 11	5 50	5 27	5 [illegible]	4 45	4 28	4 10	3 49	3 27	3 1	2 29	1 44	1 10	0 0	8 24
129	6 19	5 58	5 35	5 7	4 52	4 34	4 16	3 54	3 32	3 5	2 33	1 46	1 12	0 0	8 36
132	6 28	6 6	5 43	5 14	4 59	4 41	4 22	3 59	3 37	3 9	2 36	1 49	1 14	0 0	8 48
135	6 36	6 15	5 51	5 21	5 6	4 48	4 28	4 5	3 42	3 13	2 40	1 51	1 15	0 0	9 0
138	6 45	6 23	5 58	5 28	5 12	4 54	4 34	4 10	3 47	3 17	2 43	1 54	1 17	0 0	9 12
141	6 54	6 31	6 6	5 35	5 19	5 0	4 40	4 15	3 52	3 21	2 46	1 56	1 19	0 0	9 24
144	7 3	6 39	6 14	5 42	5 26	5 6	4 46	4 21	3 57	3 26	2 50	1 59	1 20	0 0	9 36
147	7 12	6 48	6 22	5 49	5 33	5 13	4 52	4 27	4 2	3 30	2 54	2 1	1 22	0 0	9 48
150	7 21	6 57	6 30	5 57	5 40	5 20	4 58	4 33	4 7	3 35	2 58	2 4	1 24	0 0	10 0
153	7 30	7 5	6 37	6 4	5 46	5 26	5 3	4 38	4 11	3 39	3 1	2 6	1 25	0 0	10 12
156	7 39	7 13	6 45	6 11	5 53	5 32	5 9	4 43	4 16	3 43	3 4	2 9	1 27	0 0	10 24
159	7 48	7 21	6 53	6 18	6 0	5 38	5 15	4 48	4 21	3 47	3 8	2 11	1 29	0 0	10 36
162	7 57	7 29	7 1	6 25	6 7	5 45	5 21	4 54	4 26	3 51	3 12	2 13	1 30	0 0	10 48
165	8 5	7 38	7 9	6 32	6 14	5 52	5 26	5 0	4 31	3 56	3 16	2 15	1 32	0 0	11 0
168	8 14	7 46	7 16	6 39	6 20	5 58	5 32	5 6	4 36	4 0	3 19	2 17	1 34	0 0	11 12
171	8 23	7 54	7 24	6 46	6 27	6 4	5 38	5 11	4 41	4 4	3 22	2 20	1 35	0 0	11 24
174	8 32	8 3	7 32	6 53	6 34	6 10	5 44	5 17	4 46	4 9	3 26	2 22	1 37	0 0	11 36
177	8 41	8 12	7 40	7 1	6 41	6 17	5 51	5 23	4 51	4 14	3 30	2 25	1 39	0 0	11 48

TABLE 32.—Natural Sines.

′	0°	1°	2°	3°	4°	5°	6°	7°	8°	9°	′
0	000000	017452	034899	052336	069756	087156	104528	121869	139173	156434	60
1	000291	017743	035190	052626	070047	087446	104818	122158	139461	156722	59
2	000582	018034	035481	052917	070337	087735	105107	122447	139749	157009	58
3	000873	018325	035772	053207	070627	088025	105396	122735	140037	157296	57
4	001164	018616	036062	053498	070917	088315	105686	123024	140325	157584	56
5	001454	018907	036353	053788	071207	088605	105975	123313	140613	157871	55
6	001745	019197	036644	054079	071497	088894	106264	123601	140901	158158	54
7	002036	019488	036934	054369	071788	089184	106553	123890	141189	158445	53
8	002327	019779	037225	054660	072078	089474	106843	124179	141477	158732	52
9	002618	020070	037516	054950	072368	089763	107132	124467	141765	159020	51
10	002909	020361	037806	055241	072658	090053	107421	124756	142053	159307	50
11	003200	020652	038097	055531	072948	090343	107710	125045	142341	159594	49
12	003491	020942	038388	055822	073238	090633	107999	125333	142629	159881	48
13	003782	021233	038678	056112	073528	090922	108289	125622	142917	160168	47
14	004072	021524	038969	056402	073818	091212	108578	125910	143205	160455	46
15	004363	021815	039260	056693	074108	091502	108867	126199	143493	160743	45
16	004654	022106	039550	056983	074399	091791	109156	126488	143780	161030	44
17	004945	022397	039841	057274	074689	092081	109445	126776	144068	161317	43
18	005236	022687	040132	057564	074979	092371	109734	127065	144356	161604	42
19	005527	022978	040422	057854	075269	092660	110023	127353	144644	161891	41
20	005818	023269	040713	058145	075559	092950	110313	127642	144932	162178	40
21	006109	023560	041004	058435	075849	093239	110602	127930	145220	162465	39
22	006399	023851	041294	058726	076139	093529	110891	128219	145507	162752	38
23	006690	024141	041585	059016	076429	093819	111180	128507	145795	163039	37
24	006981	024432	041876	059306	076719	094108	111469	128796	146083	163326	36
25	007272	024723	042166	059597	077009	094398	111758	129084	146371	163613	35
26	007563	025014	042457	059887	077299	094687	112047	129373	146659	163900	34
27	007854	025305	042748	060177	077589	094977	112336	129661	146946	164187	33
28	008145	025595	043038	060468	077879	095267	112625	129949	147234	164474	32
29	008436	025886	043329	060758	078169	095556	112914	130238	147522	164761	31
30	008727	026177	043619	061049	078459	095846	113203	130526	147809	165048	30
31	009017	026468	043910	061339	078749	096135	113492	130815	148097	165334	29
32	009308	026759	044201	061629	079039	096425	113781	131103	148358	165621	28
33	009599	027049	044491	061920	079329	096714	114070	131391	148672	165908	27
34	009890	027340	044782	062210	079619	097004	114359	131680	148960	166195	26
35	010181	027631	045072	062500	079909	097293	114648	131968	149248	166482	25
36	010472	027922	045362	062791	080199	097583	114937	132256	149535	166769	24
37	010763	028212	045654	063081	080489	097872	115226	132545	149823	167056	23
38	011054	028503	045944	063371	080779	098162	115515	132833	150111	167342	22
39	011344	028794	046235	063661	081069	098451	115804	133121	150398	167629	21
40	011635	029085	046525	063952	081359	098741	116093	133410	150686	167916	20
41	011926	029375	046816	064242	081649	099030	116382	133698	150973	168203	19
42	012217	029666	047106	064532	081939	099320	116671	133986	151261	168489	18
43	012508	029957	047397	064823	082228	099609	116960	134274	151548	168776	17
44	012799	030248	047688	065113	082518	099899	117249	134563	151836	169063	16
45	013090	030539	047978	065403	082808	100188	117537	134851	152123	169350	15
46	013380	030829	048269	065693	083098	100477	117826	135139	152411	169636	14
47	013671	031120	048559	065984	083388	100767	118115	135427	152698	169923	13
48	013962	031411	048850	066274	083678	101056	118404	135716	152986	170209	12
49	014253	031702	049140	066564	083968	101346	118693	136004	153273	170496	11
50	014544	031992	049431	066854	084258	101635	118982	136292	153561	170783	10
51	014835	032283	049721	067145	084547	101924	119270	136580	153848	171069	9
52	015126	032574	050012	067435	084837	102214	119559	136868	154136	171356	8
53	015416	032864	050302	067725	085127	102503	119848	137156	154423	171643	7
54	015707	033155	050593	068015	085417	102793	120137	137445	154710	171929	6
55	015998	033446	050883	068306	085707	103082	120426	137733	154998	172216	5
56	016289	033737	051174	068596	085997	103371	120714	138021	155285	172502	4
57	016580	034027	051464	068886	086286	103661	121003	138309	155572	172789	3
58	016871	034318	051755	069176	086576	103950	121292	138597	155860	173075	2
59	017162	034609	052045	069466	086866	104239	121581	138885	156147	173362	1
60	017452	034899	052336	069756	087156	104528	121869	139173	156434	173648	0
′	89°	88°	87°	86°	85°	84°	83°	82°	81°	80°	′

Natural Co-sines.

Diff. to 100″	485	485	484	484	483	483	482	481	480	478

TABLE 32.—Natural Sines.

M	10°	11°	12°	13°	14°	15°	16°	17°	18°	19°	M
0	173648	190809	207912	224951	241922	258819	275637	292372	309017	325568	60
1	173935	191095	208196	225234	242204	259100	275917	292650	309294	325843	59
2	174221	191380	208481	225518	242486	259381	276197	292928	309570	326118	58
3	174508	191666	208765	225801	242769	259662	276476	293206	309847	326393	57
4	174794	191951	209050	226085	243051	259943	276756	293484	310123	326668	56
5	175080	192237	209334	226368	243333	260224	277035	293762	310400	326943	55
6	175367	192522	209619	226651	243615	260505	277315	294040	310676	327218	54
7	175653	192807	209903	226935	243897	260785	277594	294318	310953	327493	53
8	175939	193093	210187	227218	244179	261066	277874	294596	311229	327768	52
9	176226	193378	210472	227501	244461	261347	278153	294874	311506	328042	51
10	176512	193664	210756	227784	244743	261628	278432	295152	311782	328317	50
11	176798	193949	211040	228068	245025	261908	278712	295430	312059	328592	49
12	177085	194234	211325	228351	245307	262189	278991	295708	312335	328867	48
13	177371	194520	211609	228634	245589	262470	279270	295986	312611	329141	47
14	177657	194805	211893	228917	245871	262751	279550	296264	312888	329416	46
15	177944	195090	212178	229200	246153	263031	279829	296542	313164	329691	45
16	178230	195376	212462	229484	246435	263312	280108	296819	313440	329965	44
17	178516	195661	212746	229767	246717	263592	280388	297097	313716	330240	43
18	178802	195946	213030	230050	246999	263873	280667	297375	313992	330514	42
19	179088	196231	213315	230333	247281	264154	280946	297653	314269	330789	41
20	179375	196517	213599	230616	247563	264434	281225	297930	314545	331063	40
21	179661	196802	213883	230899	247845	264715	281504	298208	314821	331338	39
22	179947	197087	214167	231182	248126	264995	281783	298486	315097	331612	38
23	180233	197372	214451	231465	248408	265276	282062	298763	315373	331887	37
24	180519	197657	214735	231748	248690	265556	282341	299041	315649	332161	36
25	180805	197942	215019	232031	248972	265837	282620	299318	315925	332435	35
26	181091	198228	215303	232314	249253	266117	282900	299596	316201	332710	34
27	181377	198513	215588	232597	249535	266397	283179	299873	316477	332984	33
28	181663	198798	215872	232880	249817	266678	283457	300151	316753	333258	32
29	181950	199083	216156	233163	250098	266958	283736	300428	317029	333523	31
30	182236	199368	216440	233445	250380	267238	284015	300706	317305	333807	30
31	182522	199653	216724	233728	250662	267519	284294	300983	317580	334081	29
32	182808	199938	217008	234011	250943	267799	284573	301261	317856	334355	28
33	183094	200223	217292	234294	251225	268079	284852	301538	318132	334629	27
34	183379	200508	217575	234577	251506	268359	285131	301815	318408	334903	26
35	183665	200793	217859	234859	251788	268640	285410	302093	318684	335178	25
36	183951	201078	218143	235142	252069	268920	285688	302370	318959	335452	24
37	184237	201363	218427	235425	252351	269200	285967	302647	319235	335726	23
38	184523	201648	218711	235708	252632	269480	286246	302924	319511	336000	22
39	184809	201933	218995	235990	252914	269760	286525	303202	319786	336274	21
40	185095	202218	219279	236273	253195	270040	286803	303479	320062	336547	20
41	185381	202502	219562	236556	253477	270320	287082	303756	320337	336821	19
42	185667	202787	219846	236838	253758	270600	287361	304033	320613	337095	18
43	185952	203072	220130	237121	254039	270880	287639	304310	320889	337369	17
44	186238	203357	220414	237403	254321	271160	287918	304587	321164	337643	16
45	186524	203642	220697	237686	254602	271440	288196	304864	321439	337917	15
46	186810	203927	220981	237968	254883	271720	288475	305141	321715	338190	14
47	187096	204211	221265	238251	255165	272000	288753	305418	321990	338464	13
48	187381	204496	221548	238533	255446	272280	289032	305695	322266	338738	12
49	187667	204781	221832	238816	255727	272560	289310	305972	322541	339012	11
50	187953	205065	222116	239098	256008	272840	289589	306249	322816	339285	10
51	188238	205350	222399	239381	256289	273120	289867	306526	323092	339559	9
52	188524	205635	222683	239663	256571	273400	290145	306803	323367	339832	8
53	188810	205920	222967	239946	256852	273679	290424	307080	323642	340106	7
54	189095	206204	223250	240228	257133	273959	290702	307357	323917	340380	6
55	189381	206489	223534	240510	257414	274239	290981	307633	324193	340653	5
56	189667	206773	223817	240793	257695	274519	291259	307910	324468	340927	4
57	189952	207058	224101	241075	257976	274798	291537	308187	324743	341200	3
58	190238	207343	224384	241357	258257	275078	291815	308464	325018	341473	2
59	190523	207627	224668	241640	258538	275358	292094	308740	325293	341747	1
60	190809	207912	224951	241922	258819	275637	292372	309017	325568	342020	0
M	79°	78°	77°	76°	75°	74°	73°	72°	71°	70°	M

Natural Co-sines.

Diff. to 100″ 477	475	473	471	469	467	465	462	460	457	Z

TABLE 32.—Natural Sines.

M	20°	21°	22°	23°	24°	25°	26°	27°	28°	29°	M
0	342020	358368	374607	390731	406737	422618	438371	453990	469472	484810	60
1	342293	358640	374876	390999	407002	422882	438633	454250	469728	485064	59
2	342567	358911	375146	391267	407268	423145	438894	454509	469985	485318	58
3	342840	359183	375416	391534	407534	423409	439155	454768	470242	485573	57
4	343113	359454	375685	391802	407799	423673	439417	455027	470499	485827	56
5	343387	359725	375955	392070	408065	423936	439678	455286	470755	486081	55
6	343660	359997	376224	392337	408330	424199	439939	455545	471012	486335	54
7	343933	360268	376494	392605	408596	424463	440200	455804	471268	486590	53
8	344206	360540	376763	392872	408861	424726	440462	456063	471525	486844	52
9	344479	360811	377033	393140	409127	424990	440723	456322	471782	487098	51
10	344752	361082	377302	393407	409392	425253	440984	456580	472038	487352	50
11	345025	361353	377571	393675	409658	425516	441245	456839	472294	487606	49
12	345298	361625	377841	393942	409923	425779	441506	457098	472551	487860	48
13	345571	361896	378110	394209	410188	426042	441767	457357	472807	488114	47
14	345844	362167	378379	394477	410454	426306	442028	457615	473063	488367	46
15	346117	362438	378649	394744	410719	426569	442289	457874	473320	488621	45
16	346390	362709	378918	395011	410984	426832	442550	458133	473576	488875	44
17	346663	362980	379187	395278	411249	427095	442810	458391	473832	489129	43
18	346936	363251	379456	395546	411514	427358	443071	458650	474088	489382	42
19	347208	363522	379725	395813	411779	427621	443332	458908	474344	489636	41
20	347481	363793	379994	396080	412045	427884	443593	459166	474600	489890	40
21	347754	364064	380263	396347	412310	428147	443853	459425	474856	490143	39
22	348027	364335	380532	396614	412575	428410	444114	459683	475112	490397	38
23	348299	364606	380801	396881	412840	428672	444375	459942	475368	490650	37
24	348572	364877	381070	397148	413104	428935	444635	460200	475624	490904	36
25	348845	365148	381339	397415	413369	429198	444896	460458	475880	491157	35
26	349117	365418	381608	397682	413634	429461	445156	460716	476136	491411	34
27	349390	365689	381877	397949	413899	429723	445417	460974	476392	491664	33
28	349662	365960	382146	398215	414164	429986	445677	461232	476647	491917	32
29	349935	366231	382415	398482	414429	430249	445937	461491	476903	492170	31
30	350207	366501	382683	398749	414693	430511	446198	461749	477159	492424	30
31	350480	366772	382952	399016	414958	430774	446458	462007	477414	492677	29
32	350752	367042	383221	399283	415223	431036	446718	462265	477670	492930	28
33	351025	367313	383490	399549	415487	431299	446979	462523	477925	493183	27
34	351297	367584	383758	399816	415752	431561	447239	462780	478181	493436	26
35	351569	367854	384027	400082	416016	431823	447499	463038	478436	493689	25
36	351842	368125	384295	400349	416281	432086	447759	463296	478692	493942	24
37	352114	368395	384564	400616	416545	432348	448019	463554	478947	494195	23
38	352386	368665	384832	400882	416810	432610	448279	463812	479203	494448	22
39	352658	368936	385101	401149	417074	432873	448539	464069	479458	494700	21
40	352931	369206	385369	401415	417338	433135	448799	464327	479713	494953	20
41	353203	369476	385638	401681	417603	433397	449059	464584	479968	495206	19
42	353475	369747	385906	401948	417867	433659	449319	464842	480223	495459	18
43	353747	370017	386174	402214	418131	433921	449579	465100	480479	495711	17
44	354019	370287	386443	402480	418396	434183	449839	465357	480734	495964	16
45	354291	370557	386711	402747	418660	434445	450098	465615	480989	496217	15
46	354563	370828	386979	403013	418924	434707	450358	465872	481244	496469	14
47	354835	371098	387247	403279	419188	434969	450618	466129	481499	496722	13
48	355107	371368	387516	403545	419452	435231	450878	466387	481754	496974	12
49	355379	371638	387784	403811	419716	435493	451137	466644	482009	497226	11
50	355651	371908	388052	404078	419980	435755	451397	466901	482263	497479	10
51	355923	372178	388320	404344	420244	436017	451656	467158	482518	497731	9
52	356194	372448	388588	404610	420508	436278	451916	467416	482773	497983	8
53	356466	372718	388856	404876	420772	436540	452175	467673	483028	498236	7
54	356738	372988	389124	405142	421036	436802	452435	467930	483282	498488	6
55	357010	373258	389392	405408	421300	437063	452694	468187	483537	498740	5
56	357281	373528	389660	405673	421563	437325	452953	468444	483792	498992	4
57	357553	373797	389928	405939	421827	437587	453213	468701	484046	499244	3
58	357825	374067	390196	406205	422091	437848	453472	468958	484301	499496	2
59	358096	374337	390463	406471	422355	438110	453731	469215	484555	499748	1
60	358368	374607	390731	406737	422618	438371	453990	469472	484810	500000	0
M	69°	68°	67°	66°	65°	64°	63°	62°	61°	60°	M

Natural Co-sines.

Dif. to 100″	454	451	448	445	441	438	434	430	426	422

TABLE 32.—Natural Sines.

M	30°	31°	32°	33°	34°	35°	36°	37°	38°	39°	M
0	500000	515038	529919	544639	559193	573576	587785	601815	615661	629320	60
1	500252	515287	530166	544883	559434	573815	588021	602047	615891	629546	59
2	500504	515537	530413	545127	559675	574053	588256	602280	616120	629772	58
3	500756	515786	530659	545371	559916	574291	588491	602512	616349	629998	57
4	501007	516035	530906	545615	560157	574529	588726	602744	616578	630224	56
5	501259	516284	531152	545858	560398	574767	588961	602976	616807	630450	55
6	501511	516533	531399	546102	560639	575005	589196	603208	617036	630676	54
7	501762	516782	531645	546346	560880	575243	589431	603440	617265	630902	53
8	502014	517031	531891	546589	561121	575481	589666	603672	617494	631127	52
9	502266	517280	532138	546833	561361	575719	589901	603904	617722	631353	51
10	502517	517529	532384	547076	561602	575957	590136	604136	617951	631578	50
11	502769	517778	532630	547320	561843	576195	590371	604367	618180	631804	49
12	503020	518027	532876	547563	562083	576432	590606	604599	618408	632029	48
13	503271	518276	533122	547807	562324	576670	590840	604831	618637	632255	47
14	503523	518525	533368	548050	562564	576908	591075	605062	618865	632480	46
15	503774	518773	533615	548293	562805	577145	591310	605294	619094	632705	45
16	504025	519022	533861	548536	563045	577383	591544	605526	619322	632931	44
17	504276	519271	534106	548780	563286	577620	591779	605757	619551	633156	43
18	504528	519519	534352	549023	563526	577858	592013	605988	619779	633381	42
19	504779	519768	534598	549266	563766	578095	592248	606220	620007	633606	41
20	505030	520016	534844	549509	564007	578332	592482	606451	620235	633831	40
21	505281	520265	535090	549752	564247	578570	592716	606682	620464	634056	39
22	505532	520513	535335	549995	564487	578807	592951	606914	620692	634281	38
23	505783	520761	535581	550238	564727	579044	593185	607145	620920	634506	37
24	506034	521010	535827	550481	564967	579281	593419	607376	621148	634731	36
25	506285	521258	536072	550724	565207	579518	593653	607607	621376	634955	35
26	506535	521506	536318	550966	565447	579755	593887	607838	621604	635180	34
27	506786	521754	536563	551209	565687	579992	594121	608069	621831	635405	33
28	507037	522002	536809	551452	565927	580229	594355	608300	622059	635629	32
29	507288	522251	537054	551694	566166	580466	594589	608531	622287	635854	31
30	507538	522499	537300	551937	566406	580703	594823	608761	622515	636078	30
31	507789	522747	537545	552180	566646	580940	595057	608992	622742	636303	29
32	508040	522995	537790	552422	566886	581176	595290	609223	622970	636527	28
33	508290	523242	538035	552664	567125	581413	595524	609454	623197	636751	27
34	508541	523490	538281	552907	567365	581650	595758	609684	623425	636976	26
35	508791	523738	538526	553149	567604	581886	595991	609915	623652	637200	25
36	509041	523986	538771	553392	567844	582123	596225	610145	623880	637424	24
37	509292	524234	539016	553634	568083	582359	596458	610376	624107	637648	23
38	509542	524481	539261	553876	568323	582596	596692	610606	624334	637872	22
39	509792	524729	539506	554118	568562	582832	596925	610836	624561	638096	21
40	510043	524977	539751	554360	568801	583069	597159	611067	624789	638320	20
41	510293	525224	539996	554602	569040	583305	597392	611297	625016	638544	19
42	510543	525472	540240	554844	569280	583541	597625	611527	625243	638768	18
43	510793	525719	540485	555086	569519	583777	597858	611757	625470	638992	17
44	511043	525967	540730	555328	569758	584014	598092	611987	625697	639215	16
45	511293	526214	540974	555570	569997	584250	598325	612217	625923	639439	15
46	511543	526461	541219	555812	570236	584486	598558	612447	626150	639663	14
47	511793	526709	541464	556054	570475	584722	598791	612677	626377	639886	13
48	512043	526956	541708	556296	570714	584958	599024	612907	626604	640110	12
49	512293	527208	541953	556537	570952	585194	599256	613137	626830	640333	11
50	512543	527450	542197	556779	571191	585429	599489	613367	627057	640557	10
51	512792	527697	542442	557021	571430	585665	599722	613596	627284	640780	9
52	513042	527944	542686	557262	571669	585901	599955	613826	627510	641003	8
53	513292	528191	542930	557504	571907	586137	600188	614056	627737	641226	7
54	513541	528438	543174	557745	572146	586372	600420	614285	627963	641450	6
55	513791	528685	543419	557987	572384	586608	600653	614515	628189	641673	5
56	514040	528932	543663	558228	572623	586844	600885	614744	628416	641896	4
57	514290	529179	543907	558469	572861	587079	601118	614974	628642	642119	3
58	514539	529426	544151	558710	573100	587314	601350	615203	628868	642342	2
59	514789	529673	544395	558952	573338	587550	601583	615432	629094	642565	1
60	515038	529919	544639	559193	573576	587785	601815	615661	629320	642788	0
M	59°	58°	57°	56°	55°	54°	53°	52°	51°	50°	M

Natural Co-sines.

Dif. to 100″	418	413	409	404	399	394	390	385	380	374

TABLE 32.—Natural Sines.

M	40°	41°	42°	43°	44°	45°	46°	47°	48°	49°	M
0	642788	656059	669131	681998	694658	707107	719340	731354	743145	754710	60
1	643010	656279	669347	682211	694868	707312	719542	731552	743339	754900	59
2	643233	656498	669563	682424	695077	707518	719744	731750	743534	755091	58
3	643456	656717	669779	682636	695286	707723	719946	731949	743728	755282	57
4	643679	656937	669995	682849	695495	707929	720148	732147	743923	755472	56
5	643901	657156	670211	683061	695704	708134	720349	732345	744117	755663	55
6	644124	657375	670427	683274	695913	708340	720551	732543	744312	755853	54
7	644346	657594	670642	683486	696122	708545	720753	732741	744506	756044	53
8	644569	657814	670858	683698	696330	708750	720954	732939	744700	756234	52
9	644791	658033	671074	683911	696539	708956	721156	733137	744894	756425	51
10	645013	658252	671289	684123	696748	709161	721357	733334	745088	756615	50
11	645236	658471	671505	684335	696957	709366	721559	733532	745282	756805	49
12	645458	658689	671721	684547	697165	709571	721760	733730	745476	756995	48
13	645680	658908	671936	684759	697374	709776	721962	733927	745670	757185	47
14	645902	659127	672151	684971	697582	709981	722163	734125	745864	757375	46
15	646124	659346	672367	685183	697790	710185	722364	734323	746057	757565	45
16	646346	659565	672582	685395	697999	710390	722565	734520	746251	757755	44
17	646568	659783	672797	685607	698207	710595	722766	734717	746445	757945	43
18	646790	660002	673013	685818	698415	710799	722967	734915	746638	758134	42
19	647012	660220	673228	686030	698623	711004	723168	735112	746832	758324	41
20	647233	660439	673443	686242	698832	711209	723369	735309	747025	758514	40
21	647455	660657	673658	686453	699040	711413	723570	735506	747218	758703	39
22	647677	660875	673873	686665	699248	711617	723771	735703	747412	758893	38
23	647898	661094	674088	686876	699455	711822	723971	735900	747605	759082	37
24	648120	661312	674302	687088	699663	712026	724172	736097	747798	759271	36
25	648341	661530	674517	687299	699871	712230	724372	736294	747991	759461	35
26	648563	661748	674732	687510	700079	712434	724573	736491	748184	759650	34
27	648784	661966	674947	687721	700287	712639	724773	736687	748377	759839	33
28	649006	662184	675161	687932	700494	712843	724974	736884	748570	760028	32
29	649227	662402	675376	688144	700702	713047	725174	737081	748763	760217	31
30	649448	662620	675590	688355	700909	713250	725374	737277	748956	760406	30
31	649669	662838	675805	688566	701117	713454	725575	737474	749148	760595	29
32	649890	663056	676019	688776	701324	713658	725775	737670	749341	760784	28
33	650111	663273	676233	688987	701531	713862	725975	737867	749534	760972	27
34	650332	663491	676448	689198	701739	714066	726175	738063	749726	761161	26
35	650553	663709	676662	689409	701946	714269	726375	738259	749919	761350	25
36	650774	663926	676876	689620	702153	714473	726575	738455	750111	761538	24
37	650995	664144	677090	689830	702360	714676	726775	738651	750303	761727	23
38	651216	664361	677304	690041	702567	714880	726974	738848	750496	761915	22
39	651437	664579	677518	690251	702774	715083	727174	739043	750688	762104	21
40	651657	664796	677732	690462	702981	715286	727374	739239	750880	762292	20
41	651878	665013	677946	690672	703188	715490	727573	739435	751072	762480	19
42	652098	665230	678160	690882	703395	715693	727773	739631	751264	762668	18
43	652319	665448	678373	691093	703601	715896	727972	739827	751456	762856	17
44	652539	665665	678587	691303	703808	716099	728172	740023	751648	763044	16
45	652760	665882	678801	691513	704015	716302	728371	740218	751840	763232	15
46	652980	666099	679014	691723	704221	716505	728570	740414	752032	763420	14
47	653200	666316	679228	691933	704428	716708	728769	740609	752223	763608	13
48	653421	666532	679441	692143	704634	716911	728969	740805	752415	763796	12
49	653641	666749	679655	692353	704841	717113	729168	741000	752606	763984	11
50	653861	666966	679868	692563	705047	717316	729367	741195	752798	764171	10
51	654081	667183	680081	692773	705253	717519	729566	741391	752989	764359	9
52	654301	667399	680295	692983	705459	717721	729765	741586	753181	764547	8
53	654521	667616	680508	693192	705665	717924	729963	741781	753372	764734	7
54	654741	667833	680721	693402	705872	718126	730162	741976	753563	764921	6
55	654961	668049	680934	693611	706078	718329	730361	742171	753755	765109	5
56	655180	668265	681147	693821	706284	718531	730560	742366	753946	765296	4
57	655400	668482	681360	694030	706489	718733	730758	742561	754137	765483	3
58	655620	668698	681573	694240	706695	718936	730957	742755	754328	765670	2
59	655839	668914	681786	694449	706901	719138	731155	742950	754519	765857	1
60	656059	669131	681998	694658	707107	719340	731354	743145	754710	766044	0
M	49°	48°	47°	46°	45°	44°	43°	42°	41°	40°	M

Natural Co-sines.

Diff to 100″	369	363	357	352	346	340	334	327	321	315

TABLE 32.—NATURAL SINES.

M	50°	51°	52°	53°	54°	55°	56°	57°	58°	59°	M
0	766044	777146	788011	798636	809017	819152	829038	838671	848048	857167	60
1	766231	777329	788190	798811	809188	819319	829200	838829	848202	857317	59
2	766418	777512	788369	798985	809359	819486	829363	838987	848356	857467	58
3	766605	777695	788548	799160	809530	819652	829525	839146	848510	857616	57
4	766792	777878	788727	799335	809700	819819	829688	839304	848664	857766	56
5	766979	778060	788905	769510	809871	819985	829850	839462	848818	857915	55
6	767165	778243	789084	799685	810042	820152	830012	839620	848972	858065	54
7	767352	778426	789263	799859	810212	820318	830174	839778	849125	858211	53
8	767538	778608	789441	800034	810383	820485	880337	839936	849279	858364	52
9	767725	778791	789620	800208	810553	820651	830499	840094	849433	858513	51
10	767911	778973	789798	800383	810723	820817	830661	840251	849586	858662	50
11	768097	779156	789977	800557	810894	820983	830823	840409	849739	858811	49
12	768284	779338	790155	800731	811064	821149	830984	840567	849893	858960	48
13	768470	779520	790333	800906	811234	821315	831146	840724	850046	859109	47
14	768656	779702	790511	801080	811404	821481	831308	840882	850199	859258	46
15	768842	779884	790690	801254	811574	821647	831470	841039	850352	859406	45
16	769028	780067	790868	801428	811744	821813	831631	841196	850505	859555	44
17	769214	780249	791046	801602	811914	821978	831793	841354	850658	859704	43
18	769400	780430	791224	801776	812084	822144	831954	841511	850811	859852	42
19	769585	780612	791401	801949	812253	822310	832115	841668	850964	860001	41
20	769771	780794	791579	802123	812423	822475	832277	841825	851117	860149	40
21	769957	780976	791757	802297	812592	822641	832438	841982	851269	860297	39
22	770142	781157	791935	802470	812762	822806	832599	842139	851422	860446	38
23	770328	781339	792112	802644	812931	822971	832760	842296	851575	860594	37
24	770513	781520	792290	802817	813101	823136	832921	842452	851727	860742	36
25	770699	781702	792467	802991	813270	823302	833082	842609	851879	860890	35
26	770884	781883	792644	803164	813439	823467	833243	842766	852032	861038	34
27	771069	782065	792822	803337	813608	823632	833404	842922	852184	861186	33
28	771254	782246	792999	803511	813778	823797	833565	843079	852336	861334	32
29	771440	782427	793176	803684	813947	823961	833725	843235	852488	861481	31
30	771625	782608	793353	803857	814116	824126	833886	843391	852640	861629	30
31	771810	782789	793530	804030	814284	824291	834046	843548	852792	861777	29
32	771995	782970	793707	804203	814453	824456	834207	843074	852944	861924	28
33	772179	783151	793884	804376	814622	824620	834367	843860	853096	862072	27
34	772364	783332	794061	804548	814791	824785	834527	844016	853248	862219	26
35	772549	783513	794238	804721	814959	824949	834688	844172	853399	862366	25
36	772734	783693	794415	804894	815128	825113	834848	844328	853551	862514	24
37	772918	783874	794591	805066	815296	825278	835008	844484	853702	862661	23
38	773103	784055	794768	805239	815465	825442	835168	844640	853854	862808	22
39	773287	784235	794944	805411	815633	825606	835328	844795	854005	862955	21
40	773472	784416	795121	805584	815801	825770	835488	844951	854156	863102	20
41	773656	784596	795297	805756	815969	825934	835648	845106	854308	863249	19
42	773840	784776	795473	805928	816138	826098	835807	845262	854459	863396	18
43	774024	784957	795650	806100	816306	826262	835967	845417	854610	863542	17
44	774209	785137	795826	806273	816474	826426	836127	845573	854761	863689	16
45	774393	785317	796002	806445	816642	826590	836286	845728	854912	863836	15
46	774577	785497	796178	806617	816809	826753	836446	845883	855063	863982	14
47	774761	785677	796354	806788	816977	826917	836605	846038	855214	864128	13
48	774944	785857	796530	806960	817145	827081	836764	846193	855364	864275	12
49	775128	786037	796706	807132	817313	827244	836924	846348	855515	664421	11
50	775312	786217	796882	807304	817480	827407	837083	846503	855665	864567	10
51	775496	786396	797057	807475	817648	827571	837242	846658	855816	864713	9
52	775679	786576	797233	807647	817815	827734	837401	846813	855966	864860	8
53	775863	788756	797408	807818	817982	827897	837560	846967	856117	865006	7
54	776046	786935	797584	807990	818150	828060	837719	847122	856267	865151	6
55	776230	787114	797759	808161	818317	828223	837878	847277	856417	865297	5
56	776413	787294	797935	808333	818484	828386	838036	847431	856567	865443	4
57	776596	787473	798110	808504	818651	828549	838195	847585	856718	865589	3
58	776780	787652	798285	808675	818818	828712	838354	847740	856868	865734	2
59	776963	787832	798460	808846	818985	828875	838512	847894	857017	865880	1
60	777146	788011	798636	809017	819152	829038	838671	848048	857167	866025	0
M	39°	38°	37°	36°	35°	34°	33°	32°	31°	30°	M

Natural Co-sines.

Diff to 100″	309	302	295	288	282	275	268	260	253	246

TABLE 32.—Natural Sines.

M	60°	61°	62°	63°	64°	65°	66°	67°	68°	69°	M
0	866025	874620	882948	891007	898794	906308	913545	920505	927184	933580	60
1	866171	874761	863084	891139	898922	906431	913664	920618	927293	933685	59
2	866316	874902	883221	891270	899049	906554	913782	920732	927402	933789	58
3	866461	875042	883357	891402	899176	906676	913900	920846	927510	933893	57
4	866607	875183	883493	891534	899304	906799	914018	920959	927619	933997	56
5	866752	875324	883629	891666	899431	906922	914136	921072	927728	934101	55
6	866897	875465	883766	891798	899558	907044	914254	921185	927836	934204	54
7	867042	875605	883902	891929	899685	907166	914372	921299	927945	934308	53
8	867187	875746	884038	892061	899812	907289	914490	921412	928053	934412	52
9	867331	875886	884174	892192	899939	907411	914607	921525	928161	934515	51
10	867476	876026	884309	892323	900065	907533	914725	921638	928270	934619	50
11	867621	876167	884445	892455	900192	907655	914842	921750	928378	934722	49
12	867765	876307	884581	892586	900319	907777	914960	921863	928486	934826	48
13	867910	876447	884717	892717	900445	907899	915077	921976	928594	934929	47
14	868054	876587	884852	892848	900572	908021	915194	922088	928702	935032	46
15	868199	876727	884988	892979	900698	908143	915311	922201	928810	935135	45
16	868343	876867	885123	893110	900825	908265	915429	922313	928917	935238	44
17	868487	877006	885258	893241	900951	908387	915546	922426	929025	935341	43
18	868632	877146	885394	893371	901077	908508	915663	922538	929133	935444	42
19	868776	877286	885529	893502	901203	908630	915779	922650	929240	935547	41
20	868920	877425	885664	893633	901329	908751	915896	922762	929348	935650	40
21	869064	877565	885799	893763	901455	908872	916013	922874	929455	935752	39
22	869207	877704	885934	893894	901581	908994	916130	922986	929562	935855	38
23	869351	877844	886069	894024	901707	909115	916246	923098	929669	935957	37
24	869495	877983	886204	894154	901833	909236	916363	923210	929776	935060	36
25	869639	878122	886338	894284	901958	909357	916479	923322	929884	936162	35
26	869782	878261	886473	894415	902084	909478	916595	923434	929990	936264	34
27	869926	878400	886608	894545	902209	909599	916712	923545	930097	936366	33
28	870069	878539	886742	894675	902335	909720	916828	923657	930204	936468	32
29	870212	878678	886876	894805	902460	909841	916944	923768	930311	936570	31
30	870356	878817	887011	894934	902585	909961	917060	923880	930418	936672	30
31	870499	878956	887145	895064	902710	910082	917176	923991	930524	936774	29
32	870642	879095	887279	895194	902836	910202	917292	924102	930631	936876	28
33	870785	879233	887413	895323	902961	910323	917408	924213	930737	936977	27
34	870928	879372	887548	895453	903086	910443	917523	924324	930843	937079	26
35	871071	879510	887681	895582	903210	910563	917639	924435	930950	937181	25
36	871214	879649	887815	895712	903335	910684	917755	924546	931056	937282	24
37	871357	879787	887949	895841	903460	910804	917870	924657	931162	937383	23
38	871499	879925	888083	895970	903585	910924	917986	924768	931268	937485	22
39	871642	880063	888217	896099	903709	911044	918101	924878	931374	937586	21
40	871784	880201	888350	896229	903834	911164	918216	924989	931480	937687	20
41	871927	880339	888484	896358	903958	911284	918331	925099	931586	937788	19
42	872069	880477	888617	896486	904083	911403	918446	925210	931691	937889	18
43	872212	880615	888751	896615	904207	911523	918561	925320	931797	937990	17
44	872354	880753	888884	896744	904331	911643	918676	925430	931902	938091	16
45	872496	880891	889017	896873	904455	911762	918791	925541	932008	938191	15
46	872638	881028	889150	897001	904579	911881	918906	925651	932113	938292	14
47	872780	881166	889283	897130	904703	912001	919021	925761	932219	938393	13
48	872922	881303	889416	897258	904827	912120	919135	925871	932324	938493	12
49	873064	881441	889549	897387	904951	912239	919250	925980	932429	938593	11
50	873206	881578	889682	897515	905075	912358	919364	926090	932534	938694	10
51	873347	881716	889815	897643	905198	912477	919479	926200	932639	938794	9
52	873489	881853	889948	897771	905322	912596	919593	926310	932744	938894	8
53	873631	881990	890080	897900	905445	912715	919707	926419	932849	938994	7
54	873772	882127	890213	898028	905569	912834	919821	926529	932954	939094	6
55	873914	882264	890345	898156	905692	912953	919936	926638	933058	939194	5
56	874055	882401	890478	898283	905815	913072	920050	926747	933163	939294	4
57	874196	882538	890610	898411	905939	913190	920164	926857	933267	939394	3
58	874338	882674	890742	898539	906062	913309	920277	926966	933372	939493	2
59	874479	882811	890874	898666	906185	913427	920391	927075	933476	939593	1
60	874620	882948	891007	898794	906308	913545	920505	927184	933580	939693	0
M	29°	28°	27°	26°	25°	24°	23°	22°	21°	20°	M

Natural Co-sines.

Diff. to 100″	239	231	224	216	209	201	193	185	178	170

TABLE 32.—Natural Sines.

M	70°	71°	72°	73°	74°	75°	76°	77°	78°	79°	M
0	939693	945519	951057	956305	961262	965926	970296	974370	978148	981627	60
1	939792	945613	951146	956390	961342	966001	979366	974435	978208	981683	59
2	939891	945708	951236	956475	961422	966076	970436	974501	978268	981738	58
3	939991	945802	951326	956560	961502	966151	970506	974566	978329	981793	57
4	940090	945897	951415	956644	961582	966226	970577	974631	978389	981849	56
5	940189	945991	951505	956729	961662	966301	970647	974696	978449	981904	55
6	940288	946085	951594	956814	961741	966376	970716	974761	978509	981959	54
7	940387	946180	951684	956898	961821	966451	970786	974826	978569	982014	53
8	940486	946274	951773	956983	961901	966526	970856	974891	978629	982069	52
9	940585	946368	951862	957067	961980	966600	970926	974956	978689	982123	51
10	940684	946462	951951	957151	962059	966675	970995	975020	978748	982178	50
11	940782	946555	952040	957235	962139	966749	971065	975085	978808	982233	49
12	940881	946649	952129	957319	962218	966823	971131	975149	978867	982287	48
13	940979	946743	952218	957404	962297	966898	971204	975214	978927	982342	47
14	941078	946837	952307	957487	962376	966972	971273	975278	978986	982396	46
15	941176	946930	952396	957571	962455	967046	971342	975342	979045	982450	45
16	941274	947024	952484	957655	962534	967120	971411	975406	979105	982505	44
17	941372	947117	952573	957739	962613	967194	971480	975471	979164	982559	43
18	941471	947210	952661	957822	962692	967268	971549	975535	979223	982613	42
19	941569	947304	952750	957906	962770	967342	971618	975598	979282	982667	41
20	941666	947397	952838	957990	962849	967415	971687	975662	979341	982721	40
21	941764	947490	952926	958073	962928	967489	971755	975726	979399	982774	39
22	941862	947583	953015	958156	963006	967562	971824	975790	979458	982828	38
23	941960	947676	953103	958239	963084	967636	971893	975853	979517	982882	37
24	942057	947768	953191	958323	963163	967709	971961	975917	979575	982935	36
25	942155	947861	953279	958406	963241	967782	972030	975980	979634	982989	35
26	942252	947954	953366	958489	963319	967856	972098	976044	979692	983042	34
27	942350	948046	953454	958572	963397	967929	972166	976107	979750	983096	33
28	942447	948139	953542	958654	963475	968002	972234	976170	979809	983149	32
29	942544	948231	953629	958737	963553	968075	972302	976233	979867	983202	31
30	942641	948324	953717	958820	963630	968148	972370	976296	979925	983255	30
31	942739	948416	953804	958902	963708	968220	972438	976359	979983	983308	29
32	942836	948508	953892	958985	963786	968293	972506	976422	980041	983361	28
33	942932	948600	953979	959067	963863	968366	972573	976485	980098	983414	27
34	943029	948692	954066	959150	963941	968438	972641	976547	980156	983466	26
35	943126	948784	954153	959232	964018	968511	972708	976610	980214	983519	25
36	943223	948876	954240	959314	964095	968583	972776	976672	980271	983571	24
37	943319	948968	954327	959396	964173	968656	972843	976735	980329	983624	23
38	943416	949059	954414	959478	964250	968728	972911	976797	980386	983676	22
39	943512	949151	954501	959560	964327	968800	972978	976859	980443	983729	21
40	943609	949243	954588	959642	964403	968872	973045	976921	980500	983781	20
41	943705	949334	954674	959724	964481	968944	973112	976984	980558	983833	19
42	943801	949425	954761	959805	964557	969016	973179	977046	980615	983885	18
43	943897	949517	954847	959887	964634	969088	973246	977108	980672	983937	17
44	943993	949608	954934	959968	964711	969159	973313	977169	980728	983989	16
45	944089	949699	955020	960050	964787	969231	973379	977231	980785	984041	15
46	944185	949790	955106	960131	964864	969302	973446	977293	980842	984092	14
47	944281	949881	955192	960212	964940	969374	973512	977354	980899	984144	13
48	944376	949972	955278	960294	965016	969445	973579	977416	980955	984196	12
49	944472	950063	955364	960375	965093	969517	973645	977477	981012	984247	11
50	944568	950154	955450	960456	965169	969588	973712	977539	981068	984298	10
51	944663	950244	955536	960537	965245	969659	973778	977600	981124	984350	9
52	944758	950335	955622	960618	965321	969730	973844	977661	981181	984401	8
53	944854	950425	955707	960698	965397	969801	973910	977722	981237	984452	7
54	944949	950516	955793	960779	965473	969872	973976	977783	981293	984503	6
55	945044	950606	955879	960860	965548	969943	974042	977844	981349	984554	5
56	945139	950696	955964	960940	965624	970014	974108	977905	981405	984605	4
57	945234	950786	956049	961021	965700	970084	974173	977966	981460	984656	3
58	945329	950877	956134	961101	965775	970155	974239	978026	981516	984707	2
59	945424	950967	956220	961181	965850	970225	974305	978087	981572	984757	1
60	945519	951057	956309	961262	965926	970296	974370	978148	981627	984808	0
M	19°	18°	17°	16°	15°	14°	13°	12°	11°	10°	M

Natural Co-sines.

Diff. to 100″	162	154	146	138	130	121	113	105	97	88

TABLE 32.—Natural Sines.

M	80°	81°	82°	83°	84°	85°	86°	87°	88°	89°	M
0	984808	987688	990268	992546	994522	996195	997564	998630	999391	999848	60
1	984858	987734	990309	992582	994552	996220	997584	998645	999401	999853	59
2	984909	987779	990349	992617	994583	996245	997604	998660	999411	999858	58
3	984959	987824	990389	992652	994613	996270	997625	998675	999421	999863	57
4	985009	987870	990429	992687	994643	996295	997645	998690	999431	999867	56
5	985059	987915	990469	992722	994673	996320	997664	998705	999441	999872	55
6	985109	987960	990509	992757	994703	996345	997684	998719	999450	999877	54
7	985159	988005	990549	992792	994733	996370	997704	998734	999460	999881	53
8	985209	988050	990589	992827	994762	996395	997724	998749	999469	999886	52
9	985259	988094	990629	992862	994792	996419	997743	998763	999479	999890	51
10	985309	988139	990669	992896	994822	996444	997763	998778	999488	999894	50
11	985358	988184	990708	992931	994851	996468	997782	998792	999497	999898	49
12	985408	988228	990748	992966	994881	996493	997801	998806	999507	999903	48
13	985457	988273	990787	993000	994910	996517	997821	998820	999516	999907	47
14	985507	988317	990827	993034	994939	996541	997840	998834	999525	999910	46
15	985556	988362	990866	993068	994969	996566	997859	998848	999534	999914	45
16	985605	988406	990905	993103	994998	996589	997878	998862	999542	999918	44
17	985654	988450	990944	993137	995027	996614	997897	998876	999551	999922	43
18	985703	988494	990983	993171	995056	996637	997916	998890	999560	999925	42
19	985752	988538	991022	993205	995084	996661	997934	998904	999568	999929	41
20	985801	988582	991061	993238	995113	996685	997953	998917	999577	999932	40
21	985850	988626	991100	993272	995142	996709	997972	998931	999585	999936	39
22	985899	988669	991138	993306	995170	996732	997990	998944	999594	999939	38
23	985947	988713	991177	993339	995199	996756	998008	998957	999602	999942	37
24	985996	988756	991216	993373	995227	996779	998027	998971	999610	999945	36
25	986045	988800	991254	993406	995256	996802	998045	998984	999618	999948	35
26	986093	988843	991292	993439	995284	996825	998063	998997	999626	999951	34
27	986141	988886	991331	993473	995312	996848	998081	999010	999634	999954	33
28	986189	988930	991369	993506	995340	996872	998099	999023	999642	999957	32
29	986238	988973	991407	993539	995368	996894	998117	999035	999650	999959	31
30	986286	989016	991445	993572	995396	996917	998135	999048	999657	999962	30
31	986334	989059	991483	993605	995424	996940	998153	999061	999665	999964	29
32	986381	989102	991521	993638	995452	996963	998170	999073	999672	999967	28
33	986429	989145	991558	993670	995479	996985	998188	999086	999680	999969	27
34	986477	989187	991596	993703	995507	997008	998205	999098	999687	999971	26
35	986525	989230	991634	993735	995535	997030	998223	999111	999694	999974	25
36	986572	989272	991671	993768	995562	997053	998240	999123	999701	999976	24
37	986620	989315	991709	993800	995589	997075	998257	999135	999709	999978	23
38	986667	989357	991746	993833	995617	997097	998274	999147	999716	999980	22
39	986714	989399	991783	993865	995644	997119	998291	999159	999722	999981	21
40	986762	989442	991820	993897	995671	997141	998308	999171	999729	999983	20
41	986809	989484	991857	993929	995698	997163	998325	999183	999736	999985	19
42	986856	989526	991894	993961	995725	997185	998342	999194	999743	999986	18
43	986903	989568	991931	993993	995752	997207	998359	999206	999749	999988	17
44	986950	989610	991968	994025	995778	997229	998375	999218	999756	999989	16
45	986996	989651	992005	994056	995805	997250	998392	999229	999762	999990	15
46	987043	989693	992042	994088	995832	997272	998408	999240	999768	999992	14
47	987090	989735	992078	994120	995858	997293	998425	999252	999775	999993	13
48	987136	989776	992115	994151	995884	997314	998441	999263	999781	999994	12
49	987183	989818	992151	994182	995911	997336	998457	999274	999787	999995	11
50	987229	989859	992187	994214	995937	997357	998473	999285	999793	999996	10
51	987275	989900	992224	994245	995963	997378	998489	999296	999799	999997	9
52	987322	989942	992260	994276	995989	997399	998505	999307	999804	999997	8
53	987368	989983	992296	994307	996015	997420	998521	999318	999810	999998	7
54	987414	990024	992332	994338	996041	997441	998537	999328	999816	999998	6
55	987460	990065	992368	994369	996067	997462	998552	999339	999821	999999	5
56	987506	990105	992404	994400	996093	997482	998568	999350	999827	999999	4
57	987551	990146	992439	994430	996118	997503	998583	999360	999832	1000000	3
58	987597	990187	992475	994461	996144	997523	998599	999370	999837	1000000	2
59	987643	990228	992511	994491	996169	997544	998614	999381	999843	1000000	1
60	987688	990268	992546	994522	996195	997564	998630	999391	999848	1000000	0
M	9°	8°	7°	6°	5°	4°	3°	2°	1°	0°	M

Natural Co-sines.

Dif. to 100″	80	72	63	55	47	38	30	21	13	4

TABLE 33.

Logarithms of Apparent Time or Horary Angle.

0 Hour.

M	0s	5s	10s	15s	20s	25s	30s	35s	40s	45s	50s	55s	Pro. pts.	
0	4·	51921	12127	47345	72333	91715	07551	20941	32539	42770	51921	60200		
1	4·67757	74710	81147	87139	92745	98011	02976	07672	12127	16365	20406	24267		
2	5·27963	31509	34916	38194	41352	44400	46345	50193	52951	55623	58216	60734		
3	63181	65561	67877	70133	72332	74477	76570	78614	80611	82563	84472	86340		
4	$^{5}_{6}$·88168	89959	91714	93434	95121	96775	98399	99992	01557	03095	04605	06090		
5	6·07550	08985	10398	11787	13155	14502	15828	17134	18421	19689	20938	22170		
6	23385	24583	25765	26931	28081	29217	30337	31444	32536	33615	34681	35734		
7	36774	37802	38817	39821	40814	41795	42766	43726	44675	45614	46543	47462		
8	48372	49271	50162	51044	51916	52780	53636	54484	55323	56154	56977	57792		
9	58600	59401	60194	60980	61759	62531	63296	64054	64806	65552	66291	67024		
10	6·67751	68471	69186	69895	70598	71296	71988	72674	73355	74031	74702	75367	s	
11	76028	76683	77334	77979	78620	79256	79888	80515	81137	81756	82369	82979	1	119
12	83584	84185	84782	85374	85963	86548	87129	87706	88279	88848	89414	89976	2	238
13	90535	91089	91641	92189	92733	93274	93812	94346	94877	95405	95930	96451	3	358
14	$^{6}_{7}$·96970	97485	97997	98506	99013	99516	00017	00514	01009	01501	01990	02476	4	476
15	7·02960	03441	03920	04395	04869	05339	05807	06273	06736	07196	07655	08110	s	
16	08564	09015	09464	09910	10354	10796	11236	11673	12108	12541	12972	13401	1	84
17	13827	14252	14674	15095	15513	15930	16344	16756	17167	17575	17982	18387	2	168
18	18790	19191	19590	19987	20383	20776	21168	21558	21947	22333	22719	23102	3	252
19	23483	23863	24241	24618	24993	25366	25738	26108	26477	26844	27210	27573	4	336
20	7·27936	28297	28656	29014	29371	29726	30079	30431	30782	31131	31479	31826	s	
21	32171	32515	32857	33198	33538	33876	34213	34549	34884	35217	35549	35879	1	65
22	36209	36537	36864	37189	37514	37837	38159	38480	38800	39118	39435	39752	2	130
23	40067	40380	40693	41005	41315	41625	41933	42240	42546	42851	43155	43458	3	195
24	43760	44061	44361	44659	44957	45254	45549	45844	46138	46430	46722	47013	4	260
25	7·47302	47591	47879	48166	48452	48737	49021	49304	49586	49867	50148	50427	s	
26	50706	50983	51260	51536	51811	52085	52358	52631	52902	53173	53443	53712	1	53
27	53980	54247	54514	54780	55045	55308	55572	55834	56096	56357	56617	56876	2	106
28	57135	57393	57650	57906	58162	58416	58670	58924	59176	59428	59679	59929	3	159
29	60179	60428	60676	60924	61170	61417	61662	61907	62151	62394	62636	62878	4	212
30	7·63120	63360	63600	63839	64078	64316	64553	64790	65026	65261	65496	65730	s	
31	65964	66196	66429	66660	66891	67121	67351	67580	67809	68037	68264	68491	1	45
32	68717	68942	69167	69392	69616	69839	70061	70283	70505	70726	70946	71166	2	90
33	71385	71604	71822	72040	72257	72473	72689	72904	73119	73334	73548	73760	3	134
34	73974	74186	74398	74609	74819	75030	75239	75448	75657	75865	76073	76280	4	178
35	7·76487	76693	76898	77104	77308	77513	77716	77920	78122	78325	78526	78728	s	
36	78929	79129	79329	79529	79728	79926	80124	80322	80519	80716	80912	81108	1	39
37	81303	81498	81693	81887	82081	82274	82467	82659	82851	83043	83234	83424	2	77
38	83615	83804	83994	84183	84372	84560	84747	84935	85122	85308	85494	85680	3	116
39	85866	86050	86235	86419	86603	86786	86969	87152	87334	87516	87697	87878	4	154
40	7·88059	88240	88419	88599	88778	88957	89135	89314	89491	89668	89846	90022	s	
41	90198	90374	90550	90725	90900	91074	91248	91422	91596	91769	91941	92114	1	34
42	92286	92457	92629	92800	92970	93141	93311	93480	93650	93819	93987	94156	2	68
43	94324	94491	94659	94826	94992	95159	95325	95491	95656	95821	95986	96150	3	102
44	96315	96478	96642	96805	96968	97131	97293	97455	97617	97778	97939	98100	4	137
45	$^{7}_{8}$·98260	98421	98580	98740	98899	99058	99217	99375	99534	99691	99849	00006	s	
46	8·00163	00320	00476	00632	00788	00944	01099	01254	01409	01563	01717	01871	1	31
47	02025	02178	02331	02484	02636	02789	02941	03092	03244	03395	03546	03697	2	62
48	03847	03997	04147	04297	04446	04595	04744	04892	05041	05189	05336	05484	3	92
49	05631	05778	05925	06072	06218	06364	06510	06655	06800	06945	07090	07235	4	122
50	8·07379	07523	07667	07811	07954	08097	08240	08383	08525	08667	08809	08951	s	
51	09092	09233	09374	09515	09656	09796	09936	10076	10216	10355	10494	10633	1	27
52	10772	10910	11048	11187	11324	11462	11599	11736	11873	12010	12147	12283	2	55
53	12419	12555	12691	12826	12961	13096	13231	13366	13500	13634	13768	13902	3	82
54	14035	14169	14302	14434	14567	14700	14832	14964	15096	15228	15359	15490	4	110
55	8·15621	15752	15883	16013	16144	16274	16404	16533	16663	16792	16921	17050	s	
56	17179	17307	17436	17564	17692	17820	17947	18074	18202	18329	18455	18582	1	25
57	18708	18835	18961	19087	19212	19338	19463	19588	19713	19838	19963	20087	2	50
58	20211	20335	20459	20583	20706	20830	20953	21076	21198	21321	21444	21566	3	75
59	21688	21810	21932	22053	22175	22296	22417	22538	22658	22779	22899	23019	4	100

TABLE 33.

Logarithms of Apparent Time or Horary Angle.

1 Hour.

M	0s	5s	10s	15s	20s	25s	30s	35s	40s	45s	50s	55s	Pro. pts.
0	8·23140	23259	23379	23499	23618	23737	23856	23975	24090	24212	24331	24449	s
1	24567	24685	24802	24920	25037	25155	25272	25389	25505	25622	25738	25855	1 23
2	25971	26087	26203	26318	26434	26549	26664	26779	26894	27009	27123	27238	2 46
3	27352	27466	27580	27694	27807	27921	28034	28147	28260	28373	28486	28599	3 70
4	28711	28823	28935	29047	29159	29271	29383	29494	29605	29716	29827	29938	4 94
5	8·30049	30159	30270	30380	30490	30600	30710	30820	30929	31039	31148	31257	s
6	31366	31475	31583	31692	31800	31909	32016	32125	32233	32340	32448	32556	1 21
7	32663	32770	32877	32984	33091	33198	33304	33410	33517	33623	33729	33835	2 42
8	33940	34046	34151	34257	34362	34467	34572	34677	34782	34886	34991	35095	3 63
9	35199	35303	35407	35511	35614	35718	35821	35925	36028	36131	36234	36337	4 85
10	8·36439	36542	36644	36746	36849	36951	37053	37154	37256	37358	37459	37560	s
11	37662	37763	37864	37964	38065	38166	38266	38366	38467	38567	38667	38767	1 20
12	38866	38966	39066	39165	39264	39364	39463	39562	39660	39759	39858	39956	2 40
13	40055	40153	40251	40349	40447	40545	40642	40740	40837	40935	41032	41129	3 60
14	41226	41323	41420	41517	41613	41710	41806	41902	41998	42094	42191	42286	4 80
15	8·42382	42477	42573	42668	42764	42859	42954	43049	43144	43238	43333	43427	s
16	43522	43616	43710	43804	43898	43992	44086	44180	44273	44367	44460	44554	1 18
17	44647	44740	44833	44926	45018	45111	45204	45296	45388	45481	45573	45665	2 37
18	45757	45849	45940	46032	46124	46215	46306	46398	46489	46580	46671	46762	3 55
19	46852	46943	47034	47124	47215	47305	47395	47485	47575	47665	47755	47844	4 74
20	8·47934	48024	48113	48202	48292	48381	48470	48559	48647	48736	48825	48913	s
21	49002	49090	49179	49267	49355	49443	49531	49619	49706	49794	49882	49969	1 17
22	50056	50144	50231	50318	50405	50492	50579	50665	50752	50839	50925	51012	2 35
23	51098	51184	51270	51356	51442	51528	51614	51699	51785	51871	51956	52041	3 52
24	52127	52212	52297	52382	52467	52552	52636	52721	52805	52890	52974	53059	4 70
25	8·53143	53227	53311	53395	53479	53563	53646	53730	53814	53897	53980	54064	s
26	54147	54230	54313	54396	54479	54562	54645	54727	54810	54892	54975	55057	1 16
27	55139	55221	55303	55385	55467	55549	55631	55713	55794	55876	55957	56038	2 33
28	56120	56201	56282	56363	56444	56525	56606	56687	56767	56848	56928	57009	3 49
29	57089	57169	57249	57330	57410	57490	57569	57649	57729	57809	57888	57968	4 65
30	8·58047	58126	58206	58285	58364	58443	58522	58601	58680	58759	58837	58916	s
31	58994	59073	59151	59230	59308	59386	59464	59542	59620	59698	59776	59853	1 15
32	69931	60009	60086	60164	60241	60318	60395	60473	60550	60627	60704	60781	2 31
33	60857	60934	61011	61087	61164	61240	61317	61393	61469	61545	61621	61697	3 46
34	61773	61849	61925	62001	62076	62152	62228	62303	62379	62454	62529	62604	4 62
35	8·62679	62755	62830	62904	62979	63054	63129	63203	63278	63353	63427	63502	s
36	63576	63650	63724	63798	63872	63946	64020	64094	64168	64242	64315	64389	1 15
37	64463	64536	64609	64683	64756	64829	64902	64975	65048	65121	65194	65267	2 29
38	65340	65412	65485	65558	65630	65703	65775	65847	65920	65992	66064	66136	3 44
39	66208	66280	66352	66424	66496	66567	66639	66710	66782	66853	66925	66996	4 58
40	8·67067	67139	67209	67281	67352	67423	67494	67564	67635	67706	67777	67847	s
41	67918	67988	68059	68129	68199	68269	68340	68410	68480	68550	68620	68690	1 14
42	68759	68829	68899	68969	69038	69108	69177	69247	69316	69385	69454	69524	2 28
43	69593	69662	69731	69800	69869	69937	70006	70075	70144	70212	70281	70349	3 42
44	70418	70486	79554	70623	70691	70759	70827	70895	70963	71031	71099	71167	4 56
45	8·71234	71302	71370	71437	71505	71572	71640	71707	71774	71842	71909	71976	s
46	72043	72110	72177	72244	72311	72378	72444	72511	72578	72644	72711	72777	1 13
47	72844	72910	72977	73043	73109	73175	73241	73308	73374	73439	73505	73571	2 26
48	73637	73703	73768	73834	73900	73965	74031	74096	74162	74227	74292	74357	3 40
49	74423	74488	74553	74618	74683	74748	74813	74877	74942	75007	75072	75136	4 53
50	8 75201	75265	75330	75394	75458	75523	75587	75651	75715	75779	75843	75907	s
51	75971	76035	76099	76163	76227	76290	76354	76418	76481	76545	76608	76672	1 13
52	76735	76798	76862	76925	76988	77051	77114	77177	77240	77303	77366	77429	2 25
53	77492	77554	77617	77680	77742	77805	77867	77930	77992	78054	78117	78179	3 38
54	78241	78303	78365	78427	78489	78551	78613	78675	78737	78799	78861	78922	4 50
55	8·78984	79045	79107	79169	79230	79291	79353	79413	79475	79537	79598	79659	s
56	79720	79781	79842	79903	79964	80025	80085	80146	80207	80268	80328	80389	1 12
57	80449	80510	80570	80631	80691	80751	80812	80872	80932	80992	81052	81112	2 24
58	81172	81232	81292	81352	81412	81472	81531	81591	81651	81710	81770	81829	3 36
59	81889	81948	82008	82067	82126	82186	82245	82304	82363	82422	82481	82540	4 48

TABLE 33.

Logarithms of Apparent Time or Horary Angle.

2 Hours.

M	0s	5s	10s	15s	20s	25s	30s	35s	40s	45s	50s	55s	Pro. pts.	
0	8·82599	82658	82717	82776	82835	82893	82952	83011	83069	83128	83187	83245	s	
1	83303	83362	83420	83478	83537	83595	83653	83711	83769	83828	83885	83944	1	11
2	84001	84059	84117	84175	84233	84291	84348	84406	84464	84521	84579	84636	2	23
3	84694	84751	84808	84866	84923	84980	85037	85095	85152	85209	85266	85323	3	34
4	85380	85437	85494	85550	85607	85664	85721	85777	85834	85891	85947	86004	4	46
5	8·86060	86117	86173	86229	86286	86342	86398	86454	86511	86567	86623	86679	s	
6	86735	86791	86847	86903	86959	87014	87070	87126	87182	87237	87293	87348	1	11
7	87404	87460	87515	87570	87626	87681	87736	87792	87847	87902	87957	88013	2	22
8	88068	88123	88178	88233	88288	88342	88397	88452	88507	88562	88616	88671	3	33
9	88726	88780	88835	88889	88944	88998	89053	89107	89162	89216	89270	89324	4	44
10	8·89379	89433	89487	89541	89595	89649	89703	89757	89811	89865	89918	89972	s	
11	90026	90080	90133	90187	90241	90294	90348	90401	90455	90508	90562	90615	1	11
12	90668	90722	90775	90828	90881	90934	90988	91041	91094	91147	91200	91253	2	21
13	91306	91358	91411	91464	91517	91570	91622	91675	91728	91780	91833	91885	3	32
14	91938	91990	92043	92095	92147	92200	92252	92304	92356	92408	92461	92513	4	42
15	8·92565	92617	92669	92721	92773	92825	92877	92928	92980	93032	93084	93135	s	
16	93187	93239	93290	93342	93393	93445	93496	93548	93599	93651	93702	93753	1	10
17	93804	93856	93907	93958	94009	94060	94111	94162	94213	94264	94315	94366	2	20
18	94417	94468	94519	94570	94620	94671	94722	94772	94823	94874	94924	94975	3	31
19	95025	95075	95126	95176	95227	95277	95327	95378	95428	95478	95528	95578	4	41
20	8·95628	95678	95728	95778	95828	95878	95928	95978	96028	96078	96128	96178	s	
21	96227	96277	96326	96376	96426	96475	96525	96574	96624	96673	96723	96772	1	10
22	96821	96871	96920	96969	97018	97068	97117	97166	97215	97264	97313	97362	2	20
23	97411	97460	97509	97558	97607	97656	97704	97753	97802	97851	97899	97948	3	29
24	97996	98045	98094	98142	98191	98239	98288	98336	98384	98433	98481	98529	4	39
25	8·98578	98626	98674	98722	98770	98818	98866	98914	98963	99011	99058	99106	s	
26	99154	99202	99250	99298	99346	99393	99441	99489	99536	99584	99632	99679	1	10
27	$^{8}_{9}$·99727	99774	99822	99869	99917	99964	00012	00059	00106	00154	00201	00248	2	19
28	9·00295	00342	00390	00437	00484	00531	00578	00625	00672	00719	00766	00813	3	29
29	00860	00906	00953	01000	01047	01094	01140	01187	01234	01280	01327	01373	4	38
30	9·01420	01466	01513	01559	01606	01652	01698	01745	01791	01837	01884	01930	s	
31	01976	02022	02068	02114	02161	02207	02253	02299	02345	02391	02437	02483	1	9
32	02528	02574	02620	02666	02712	02757	02803	02849	02894	02940	02986	03031	2	18
33	03077	03122	03168	03213	03259	03304	03350	03395	03440	03486	03531	03576	3	28
34	03621	03667	03712	03757	03802	03847	03892	03937	03982	04027	04072	04117	4	37
35	9·04162	04207	04252	04297	04341	04386	04431	04476	04520	04565	04610	04654	s	
36	04699	04744	04788	04833	04877	04922	04966	05011	05055	05099	05144	05188	1	9
27	05232	05277	05321	05365	05409	05453	05498	05542	05586	05630	05674	05718	2	18
38	05762	05806	05850	05894	05938	05982	06025	06069	06113	06157	06200	06244	3	27
39	06288	06332	06375	06419	06462	06506	06550	06593	06637	06680	06724	06767	4	36
40	9·06810	06854	06897	06940	06984	07027	07070	07113	07157	07200	07243	07286	s	
41	07329	07372	07415	07458	07501	07544	07587	07630	07673	07716	07759	07802	1	9
42	07845	07887	07930	07973	08016	08058	08101	08144	08186	08229	08271	08314	2	17
43	08357	08399	08442	08484	08526	08569	08611	08654	08696	08738	08781	08823	3	26
44	08865	08907	08949	08992	09034	09076	09118	09160	09202	09244	09286	09328	4	35
45	9·09370	09412	09454	09496	09538	09580	09622	09663	09705	09747	09789	09830	s	
46	09872	09914	09955	09997	10039	10080	10122	10163	10205	10246	10288	10329	1	8
47	10371	10412	10453	10495	10536	10577	10619	10660	10701	10742	10784	10825	2	17
48	10866	10907	10948	10989	11030	11071	11112	11153	11194	11235	11276	11317	3	25
49	11358	11399	11440	11480	11521	11562	11603	11643	11684	11725	11765	11806	4	34
50	9·11847	11887	11928	11968	12009	12050	12090	12130	12171	12211	12252	12292	s	
51	12332	12373	12413	12453	12494	12534	12574	12614	12655	12695	12735	12775	1	8
52	12815	12855	12895	12935	12975	13015	13055	13095	13135	13175	13215	13255	2	16
53	13295	13334	13374	13414	13454	13494	13533	13573	13613	13652	13692	13732	3	24
54	13771	13811	13850	13890	13929	13969	14008	14048	14087	14126	14166	14205	4	32
55	9·14245	14284	14323	14362	14402	14441	14480	14519	14559	14598	14637	14676	s	
56	14715	14754	14793	14832	14871	14910	14949	14988	15027	15066	15105	15144	1	8
57	15183	15221	15260	15299	15338	15377	15415	15454	15493	15531	15570	15609	2	15
58	15647	15686	15724	15763	15802	15840	15879	15917	15955	15994	16032	16071	3	23
59	16109	16147	16186	16224	16262	16301	16339	16377	16415	16453	16492	16530	4	30

TABLE 33.

Logarithms of Apparent Time or Horary Angle.

3 Hours.

M	0s	5s	10s	15s	20s	25s	30s	35s	40s	45s	50s	55s	Pro. pts.
0	9·16568	16606	16644	16682	16720	16758	16796	16834	16872	16910	16948	16986	s
1	17024	17062	17100	17138	17175	17213	17251	17289	17326	17364	17402	17440	1 7
2	17477	17515	17553	17590	17628	17665	17703	17740	17778	17815	17853	17890	2 15
3	17928	17965	18003	18040	18077	18115	18152	18189	18227	18264	18301	18338	3 22
4	18376	18413	18450	18487	18524	18561	18598	18636	18673	18710	18747	18784	4 30
5	9·18821	18858	18895	18932	18968	19005	19042	19079	19116	19153	19190	19226	s
6	19263	19300	19337	19373	19410	19447	19483	19520	19557	19593	19630	19666	1 7
7	19703	19739	19776	19812	19849	19885	19922	19958	19995	20031	20067	20104	2 14
8	20140	20176	20213	20249	20285	20321	20358	20394	20430	20466	20502	20538	3 22
9	20574	20611	20647	20683	20719	20755	20791	20827	20863	20899	20935	20970	4 29
10	9·21006	21042	21078	21114	21150	21186	21221	21257	21293	21329	21364	21400	s
11	21436	21471	21507	21543	21578	21614	21650	21685	21721	21756	21792	21827	1 7
12	21863	21898	21934	21969	22004	22040	22075	22111	22146	22181	22216	22252	2 14
13	22287	22322	22358	22393	22428	22463	22498	22533	22569	22604	22639	22674	3 21
14	22709	22744	22779	22814	22849	22884	22919	22954	22989	23024	23059	23094	4 28
15	9·23128	23163	23198	23233	23268	23302	23337	23372	23407	23441	23476	23511	s
16	23545	23580	23615	23649	23684	23718	23753	23788	23822	23857	23891	23926	1 7
17	23960	23994	24029	24063	24098	24132	24166	24201	24235	24269	24304	24338	2 14
18	24372	24406	24441	24475	24509	24543	24577	24612	24646	24680	24714	24748	3 20
19	24782	24816	24850	24884	24918	24952	24986	25020	25054	25088	25122	25156	4 27
20	9·25190	25224	25257	25291	25325	25359	25393	25426	25460	25494	25527	25561	s
21	25595	25629	25662	25696	25729	25763	35796	25830	25864	25897	25931	25964	1 7
22	25998	26031	26065	26098	26132	26165	26198	26232	26265	26298	26332	26365	2 13
23	26398	26432	26465	26498	26532	26565	26598	26631	26664	26697	26731	26764	3 20
24	26797	26830	26863	26896	26929	26962	26995	27028	27061	27094	27127	27160	4 26
25	9·27193	27226	27259	27292	27325	27357	27390	27423	27456	27489	27521	27554	s
26	27587	27620	27652	27685	27718	27751	27783	27816	27848	27881	27914	27946	1 6
27	27979	28011	28044	28076	28109	28141	28174	28206	28239	28271	28304	28336	2 13
28	28368	28401	28433	28465	28498	28530	28562	28595	28627	28659	28691	28724	3 19
29	28756	28788	28820	28852	28885	28917	28949	28981	29013	29045	29077	29109	4 26
30	9·29141	29173	29205	29237	29269	29301	29333	29365	29397	29429	29461	29493	s
31	29524	29556	29588	29620	29652	29683	29715	29747	29779	29810	29842	29874	1 6
32	29905	29937	29969	30000	30032	30064	30095	30127	30158	30190	30221	30253	2 13
33	30285	30316	30347	30379	30410	30442	30473	30505	30536	30567	30599	30630	3 18
34	30661	30693	30724	30755	30787	30818	30849	30880	30912	30943	30974	31005	4 25
35	9·31036	31068	31099	31130	31161	31192	31223	31254	31285	31316	31347	31378	s
36	31409	31440	31471	31502	31533	31564	31595	31626	31657	31688	31719	31749	1 6
37	31780	31811	31842	31873	31903	31934	31965	31996	32026	32057	32088	32119	2 13
38	32149	32180	32210	32241	32272	32302	32333	32363	32394	32425	32455	32486	3 18
39	82516	32547	32577	32608	32638	32668	32699	32729	32760	32790	32820	32851	4 24
40	9·32881	32911	32942	32972	33002	33033	33063	83093	33123	33154	33184	33214	s
41	33244	33274	33304	33335	33365	33395	33425	33455	33485	33515	33545	33575	1 6
42	33605	33635	33665	33695	33725	33755	33785	33815	33845	33875	33905	33935	2 12
43	33965	33994	34024	34054	34084	34114	34143	34173	34203	34233	34262	34292	3 18
44	34322	34352	34381	34411	34441	34470	34500	34529	34559	34689	34618	34648	4 24
45	9·34677	34707	34736	34766	34795	34825	34854	34884	34913	34943	34972	35002	s
46	35031	35060	35090	35119	35148	35178	35207	35236	35266	35295	35324	35353	1 6
47	35383	35412	35441	35470	35499	35529	35558	35587	35616	35645	35674	35703	2 12
48	35733	35762	35791	35820	35849	35878	35907	35936	35965	35994	36023	36052	3 17
49	36081	36110	36139	36167	36196	36225	36254	36283	36312	36341	36369	36398	4 23
50	9·36427	36456	36485	36513	36542	36571	36599	36628	36657	36686	36714	36743	s
51	36771	36800	36829	36857	36886	36915	36943	36972	37000	37029	37057	37086	1 6
52	37114	37143	37171	37200	37228	37257	37285	37313	37342	37370	37399	37427	2 11
53	37455	37484	37512	37540	37568	37597	37625	37653	37682	37710	37738	37766	3 17
54	37794	37823	37851	37879	37907	37935	37963	37991	38020	38048	38076	38104	4 23
55	9·38132	38160	38188	38216	38244	38272	38300	38328	38356	38384	38412	38440	s
56	38468	38496	38524	38551	38579	38607	38635	38663	38691	38718	38746	38774	1 6
57	38802	38830	38857	38885	38913	38940	38968	38996	39024	39051	39079	39107	2 11
58	39134	39162	39189	39217	39245	39272	39300	39327	39355	39382	39410	39437	3 17
59	39465	39492	39520	39547	39575	39602	39630	39657	39684	39712	39739	39767	4 22

TABLE 33.

Logarithms of Apparent Time or Horary Angle.

4 Hours.

M	0s	5s	10s	15s	20s	25s	30s	35s	40s	45s	50s	55s	Pro. pts.	
0	9·39794	39821	39849	39876	39903	39931	39958	39985	40012	40040	40067	40094	s	
1	40121	40149	40176	40203	40230	40257	40284	40312	40339	40366	40393	40420	1	5
2	40447	40474	40501	40528	40555	40582	40609	40636	40663	40690	40717	40744	2	11
3	40771	40798	40825	40852	40879	40906	40933	40960	40986	41013	41040	41067	3	16
4	41094	41121	41147	41174	41201	41228	41254	41281	41308	41335	41361	41388	4	22
5	9·41415	41441	41468	41495	41521	41548	41575	41601	41628	41654	41681	41707	s	
6	41734	41761	41787	41814	41840	41867	41893	41920	41946	41972	41999	42025	1	5
7	42052	42078	42105	42131	42157	42184	42210	42236	42263	42289	42315	42342	2	10
8	42368	42394	42420	42447	42473	42499	42525	42552	42578	42604	42630	42656	3	16
9	42682	42709	42735	42761	42787	42813	42839	42865	42891	42917	42943	42969	4	21
10	9·42996	43022	43048	43074	43100	43125	43151	43177	43203	43229	43255	43281	s	
11	43307	43333	43359	43385	43411	43436	43462	43488	43514	43540	43565	43591	1	5
12	43617	43643	43669	43694	43720	43746	43771	43797	43823	43848	43874	43900	2	10
13	43925	43951	43977	44002	44028	44054	44079	44105	44130	44156	44181	44207	3	15
14	44232	44258	44283	44309	44334	44360	44385	44411	44436	44462	44487	44513	4	20
15	9·44538	44563	44589	44614	44639	44665	44690	44715	44741	44766	44791	44817	s	
16	44842	44867	44892	44918	44943	44968	44993	45019	45044	45069	45094	45119	1	5
17	45144	45170	45195	45220	45245	45270	45295	45320	45345	45370	45395	45420	2	10
18	45446	45471	45496	45521	45546	45571	45595	45620	45645	45670	45695	45720	3	15
19	45745	45770	45795	45820	45845	45870	45894	45919	45944	45969	45994	46018	4	20
20	9·46043	46068	46093	46118	46142	46167	46192	46217	46241	46266	46291	46315	s	
21	46340	46365	46389	46414	46439	46463	46488	46512	46537	46562	46586	46611	1	5
22	46635	46660	46684	46709	46733	46758	46782	46807	46831	46856	46880	46905	2	10
23	46929	46954	46978	47002	47027	47051	47076	47100	47124	47149	47173	47197	3	15
24	47222	47246	47270	47295	47319	47343	47367	47392	47416	47440	47464	47489	4	20
25	9·47513	47537	47561	47585	47610	47634	47658	47682	47706	47730	47754	47779	s	
26	47803	47827	47851	47875	47899	47923	47947	47971	47995	48019	48043	48067	1	5
27	48091	48115	48139	48163	48187	48211	48235	48258	48282	48306	48330	48354	2	10
28	48378	48402	48426	48449	48473	48497	48521	48545	48568	48592	48616	48640	3	14
29	48664	48687	48711	48735	48758	48782	48806	48830	48853	48877	48900	48924	4	19
30	9·48948	48971	48995	49019	49042	49066	49089	49113	49137	49160	49184	49207	s	
31	49231	49254	49278	49301	49325	49348	49372	49395	49419	49442	49465	49489	1	5
32	49512	49536	49559	49583	49606	49629	49653	49676	49699	49723	49746	49769	2	9
33	49793	49816	49839	49862	49886	49909	49932	49956	49979	50002	50025	50048	3	14
34	50071	50095	50118	50141	50164	50187	50211	50234	50257	50280	50303	50326	4	19
35	9·50349	50372	50395	50418	50441	50465	50488	50511	50534	50557	50580	50603	s	
36	50626	50649	50672	50694	50717	50740	50763	50786	50809	50832	50855	50878	1	5
37	50901	50924	50946	50969	50992	51015	51038	51060	51083	51106	51129	51152	2	9
38	51174	51197	51220	51243	51265	51288	51311	51334	51356	51379	51402	51424	3	14
39	51447	51470	51492	51515	51538	51560	51583	51605	51628	51651	51673	51696	4	18
40	9·51718	51741	51763	51786	51808	51831	51853	51876	51898	51921	51943	51966	s	
41	51988	52011	52033	52056	52078	52100	52123	52145	52168	52190	52212	52235	1	4
42	52257	52279	52302	52324	52346	52369	52391	52413	52435	52458	52480	52502	2	9
43	52525	52547	52569	52591	52613	52636	52658	52680	52702	52724	52747	52769	3	13
44	52791	52813	52835	52857	52879	52901	52923	52946	52968	52990	53012	53034	4	18
45	9·53056	53078	53100	53122	53144	53166	53188	53210	53232	53254	53276	53298	s	
46	53320	53342	53364	53385	53407	53429	53451	53473	53495	53517	53539	53560	1	4
47	53582	53604	53626	53648	53670	53691	53713	53735	53757	53778	53800	53822	2	9
48	53844	53865	53887	53909	53931	53952	53974	53996	54017	54039	54061	54082	3	13
49	54104	54126	54147	54169	54190	54212	54234	54255	54277	54298	54320	54341	4	18
50	9·54363	54385	54406	54428	54449	54471	54492	54514	54535	54556	54578	54599	s	
51	54621	54642	54664	54685	54707	54728	54749	54771	54792	54813	54835	54856	1	4
52	54878	54899	54920	54941	54963	54984	55005	55027	55048	55069	55091	55112	2	9
53	55133	55154	55175	55197	55218	55239	55260	55282	55303	55324	55345	55366	3	13
54	55387	55409	55430	55451	55472	55493	55514	55535	55556	55577	55598	55619	4	17
55	9·55641	55662	55683	55704	55725	55746	55767	55788	55809	55830	55851	55872	s	
56	55893	55914	55934	55955	55976	55997	56018	56039	56060	56081	56102	56123	1	4
57	56144	56164	56185	56206	56227	56248	56269	56289	56310	56331	56352	56372	2	8
58	56393	56414	56435	56456	56476	56497	56518	56538	56559	56580	56601	56621	3	13
59	56642	56663	56683	56704	56725	56745	56766	56786	56807	56828	56848	56869	4	17

TABLE 33.

Logarithms of Apparent Time or Horary Angle.

5 Hours.

M	0s	5s	10s	15s	20s	25s	30s	35s	40s	45s	50s	55s	Pro. pts.
0	9·56889	56910	56931	56951	56972	56992	57013	57033	57054	57074	57095	57115	s
1	57136	57156	57177	57197	57218	57238	57259	57279	57299	57320	57340	57361	1 4
2	57381	57402	57422	57442	57463	57483	57503	57524	57544	57564	57585	57605	2 8
3	57625	57646	57666	57686	57706	57727	57747	57767	57787	57808	57828	57848	3 12
4	57868	57889	57909	57929	57949	57969	57990	58010	58030	58050	58070	58090	4 16
5	9·58110	58131	58151	58171	58191	58211	58231	58251	58271	58291	58311	58331	s
6	58351	58371	58391	58411	58431	58451	58471	58491	58511	58531	58551	58571	1 4
7	58591	58611	58631	58651	58671	58691	58711	58731	58750	58770	58790	58810	2 8
8	58830	58850	58870	58889	58909	58929	58949	58969	58988	59008	59028	59048	3 12
9	59068	59087	59107	59127	59147	59166	59186	59206	59225	59245	59265	59283	4 16
10	9·59304	59324	59344	59363	59383	59403	59422	59442	59461	59481	59501	59520	s
11	59540	59559	59579	59599	59618	59638	59657	59677	59696	59716	59735	59755	1 4
12	59774	59794	59813	59833	59852	59872	59891	59911	59930	59950	59969	59988	2 8
13	60008	60027	60047	60066	60085	60105	60124	60144	60163	60182	60202	60221	3 12
14	60240	60260	60279	60298	60318	60337	60356	60375	60395	60414	60433	60452	4 16
15	9·60472	60491	60510	60529	60549	60568	60587	60606	60625	60645	60664	60683	s
16	60702	60721	60740	60760	60779	60798	60817	60836	60855	60874	60893	60962	1 4
17	60931	60951	60970	60989	61008	61027	61046	61065	61084	61103	61122	61141	2 8
18	61160	61179	61198	61217	61236	61255	61274	61293	61311	61330	61349	61368	3 11
19	61387	61406	61425	61444	61463	61483	61500	61519	61538	61557	61576	61595	4 15
20	9·61613	61632	61651	61670	61689	61708	61726	61745	61764	61783	61801	61820	s
21	61839	61858	61876	61895	61914	61932	61951	61970	61988	62007	62026	62045	1 4
22	62063	62082	62100	62119	62138	62156	62175	62194	62212	62231	62249	62268	2 7
23	62287	62305	62324	62342	62361	62379	62398	62416	62435	62453	62472	62490	3 11
24	62509	62527	62546	62564	62583	62601	62620	62638	62657	62675	62693	62712	4 15
25	9·62730	62749	62767	62785	62804	62822	62841	62859	62877	62896	62914	62932	s
26	62951	62969	62987	63006	63024	63042	63061	63079	63097	63115	63134	63152	1 4
27	63170	63188	63207	63225	63243	63261	63279	63298	63316	63334	63352	63370	2 7
28	63389	63407	63425	63443	63461	63479	63497	63516	63534	63552	63570	63588	3 11
29	63606	63624	63642	63660	63678	63696	63715	63733	63751	63769	63787	63805	4 15
30	9·63823	63841	63859	63877	63895	63913	63931	63949	63966	63985	64002	64020	s
31	64038	64056	64074	64092	64110	64128	64146	64164	64181	64199	64217	64235	1 4
32	64253	64271	64289	64307	64324	64342	64360	64378	64395	64413	64431	64449	2 7
33	64467	64484	64502	64520	64538	64555	64573	64591	64609	64626	64644	64662	3 11
34	64679	64697	64715	64732	64750	64768	64785	64803	64821	64838	64856	64873	4 14
35	9·64891	64909	64926	64944	64962	64979	64997	65014	65032	65050	65067	65085	s
36	65102	65120	65137	65155	65172	65190	65207	65225	65242	65260	65277	65295	1 3
37	65312	65330	65347	65365	65382	65399	65417	65434	65452	65469	65486	65504	2 7
38	65521	65539	65556	65573	65591	65608	65625	65643	65660	65677	65695	65712	3 10
39	65729	65747	65764	65781	65799	65816	65834	65850	65868	65885	65902	65919	4 14
40	9·65937	65954	65971	65988	66006	66023	66040	66057	66074	66092	66109	66126	s
41	66143	66160	66177	66194	66212	66229	66246	66263	66280	66297	66314	66331	1 3
42	66348	66366	66383	66400	66417	66434	66451	66468	66485	66492	66519	66536	2 7
43	66553	66570	66587	66604	66621	66638	66655	66672	66689	66706	66723	66740	3 10
44	66757	66774	66791	66807	66824	66841	66858	66875	66892	66909	66926	66943	4 14
45	9·66959	66976	66993	67010	67027	67044	67060	67077	67094	67111	67128	67144	s
46	67161	67178	67195	67212	67228	67215	67262	67279	67295	67312	67329	67346	1 3
47	67362	67379	67396	67412	67429	67446	67462	67479	67496	67512	67529	67546	2 7
48	67562	67579	67596	67612	67629	67646	67662	67679	67695	67712	67729	67745	3 10
49	67762	67778	67795	67811	67828	67844	67861	67878	67894	67911	67927	67944	4 13
50	9.67960	67977	67993	68010	68026	68042	68059	68075	68092	68108	68125	68141	s
51	68158	68174	68190	68207	68223	68240	68256	68272	68289	68305	68322	68338	1 3
52	68354	68371	68387	68403	68420	68436	68452	68469	68485	68501	68517	68534	2 7
53	68550	68566	68583	68599	68615	68631	68648	68664	68680	68696	68713	68729	3 10
54	68745	68761	68777	68794	68810	68826	68842	68858	68874	68891	68907	68923	4 13
55	9·68939	68955	68971	68987	69004	69020	69036	69052	69068	69084	69100	69116	s
56	69132	69148	69164	69181	69197	69213	69229	69245	69261	69277	69293	69309	1 3
57	69325	69341	69357	69373	69389	69405	69421	69437	69453	69469	69484	69500	2 6
58	69516	69532	69548	69564	69580	69596	69612	69628	69644	69660	69675	69691	3 10
59	[illegible]	69723	69739	69755	69770	69786	69802	69818	69834	69850	69866	69881	4 13

Logarithms of Apparent Time or Horary Angle.

6 Hours.

M	0s	5s	10s	15s	20s	25s	30s	35s	40s	45s	50s	55s	Pro. pts.	
0	9.69897	69913	69929	69944	69960	69976	69992	70007	70023	70039	70055	70070	s	
1	70086	70102	70118	70133	70149	70165	70180	70196	70211	70227	70243	70259	1	3
2	70274	70290	70306	70321	70337	70353	70368	70384	70399	70415	70431	70446	2	6
3	70462	70477	70493	70509	70524	70540	70555	70571	70586	70602	70617	70633	3	9
4	70648	70664	70680	70695	70710	70726	70741	70757	70772	70788	70803	70819	4	12
5	9.70834	70865	70865	70881	70896	70911	70927	70942	70958	70973	70988	71004	s	
6	71019	71035	71050	71065	71081	71096	71111	71127	71142	71157	71173	71188	1	3
7	71203	71219	71234	71249	71265	71280	71295	71310	71326	71341	71356	71371	2	6
8	71387	71402	71417	71433	71448	71463	71478	71493	71509	71524	71539	71554	3	9
9	71569	71585	71600	71615	71630	71645	71660	71676	71691	71706	71721	71736	4	12
10	9.71751	71766	71781	71797	71812	71827	71842	71857	71872	71887	71902	71917	s	
11	71932	71947	71962	71977	71992	72007	72022	72037	72052	72067	72088	72097	1	3
12	72112	72127	72142	72157	72172	72187	72202	72217	72232	72247	72262	72277	2	6
13	72292	72307	72322	72337	72352	72366	72381	72396	72411	72426	72441	72456	3	9
14	72471	72485	72500	72515	72530	72545	72560	72574	72589	72604	72619	72634	4	12
15	9.72648	72663	72678	72693	72708	72722	72737	72752	72767	72781	72796	72811	s	
16	72825	72840	72855	72870	72884	72899	72914	72928	72943	72958	72972	72987	1	3
17	73002	73016	73031	73046	73060	73075	73090	73104	73119	73134	73148	73163	2	6
18	73177	73192	73207	73221	73236	73250	73265	73279	73294	73309	73323	73338	3	9
19	73352	73367	73381	73396	73410	73425	73439	73454	73468	73483	73497	73512	4	12
20	9·73526	73541	73555	73569	73584	73598	73613	73627	73642	73656	73671	73685	s	
21	73699	73714	73728	73743	73757	73771	73786	73800	73815	73829	73843	73858	1	3
22	73872	73886	73901	73915	73929	73944	73958	73972	73987	74001	74015	74029	2	6
23	74044	74058	74072	74087	74101	74115	74129	74144	74158	74172	74186	74200	3	9
24	74215	74229	74243	74257	74272	74286	74300	74314	74328	74342	74357	74371	4	12
25	9.74385	74399	74413	74427	74442	74456	74470	74484	74498	74512	74526	74540	s	
26	74554	74569	74583	74597	74611	74625	74639	74653	74667	74681	74695	74709	1	3
27	74723	74737	74751	74765	74779	74793	74807	74821	74835	74849	74863	74877	2	5
28	74891	74905	74919	74933	74947	74961	74975	74989	75003	75017	75031	75045	3	8
29	75059	75072	75086	75100	75114	65128	75142	75156	75170	75183	75197	75211	4	11
30	9.75225	75239	75253	75267	75280	75294	75308	75322	75336	75349	75363	75377	s	
31	75391	75405	75418	75432	75446	75460	75474	75487	75501	75515	75528	75542	1	3
32	75556	75570	75583	75597	75611	75625	75638	75652	75666	75679	75693	75707	2	5
33	75720	75734	75748	75761	75775	75789	75802	75816	75830	75843	75857	75870	3	8
34	75884	75898	75911	75925	75938	75952	75966	75979	75993	76006	76020	76033	4	10
35	9.76047	76060	76074	76088	76101	76115	76128	76142	76155	76169	76182	76196	s	
36	76209	76223	76236	76250	76263	76276	76290	76303	76317	76330	76344	76357	1	3
37	76371	76384	76397	76411	76424	76438	76451	76464	76478	76491	76505	76518	2	5
38	76531	76545	76558	76571	76585	76598	76611	76625	76638	76651	76665	76678	3	8
39	76691	76705	76718	76731	76745	76758	76771	76784	76798	76811	16824	76838	4	10
40	9.76851	76864	76877	76891	76904	76917	76930	76943	76957	76970	76983	76996	s	
41	77009	77023	77036	77049	77062	77075	77089	77102	77115	77128	77141	77154	1	3
42	77167	77181	77194	77207	77220	77233	77246	77259	77272	77285	77298	77312	2	5
43	77325	77338	77351	77364	77377	77390	77403	77416	77429	77442	77455	77468	3	8
44	77481	77494	77507	77520	77533	77546	77559	77572	77585	77598	77611	77624	4	10
45	9.77637	77650	77663	77676	77689	77702	77715	77728	77741	77754	77766	77779	s	
46	77792	77805	77818	77831	77844	77857	77870	77882	77895	77908	77921	77934	1	3
47	77947	77960	77972	77985	77998	78011	78024	78037	78049	78062	78075	78088	2	5
48	78101	78113	78126	78139	78152	78164	78177	78190	78203	78215	78228	78241	3	8
49	78254	78266	78279	78292	78305	78317	78330	78343	78355	78368	78381	78393	4	10
50	9.78406	78419	78431	78444	78457	78469	78482	78495	78507	78520	78533	78545	s	
51	78558	78570	78583	78596	78608	78621	78633	78646	78659	78671	78684	78696	1	2
52	78709	78721	78734	78747	78759	78772	78784	78797	78809	78822	78834	78847	2	5
53	78858	78872	78884	78897	78909	78922	78934	78947	78959	78972	78984	78997	3	7
54	79009	79021	79034	79046	79059	79071	79084	79096	79108	79121	79133	79146	4	10
55	9·79158	79170	79183	79195	79208	79220	79232	79245	79257	79269	79282	79294	s	
56	79306	79319	79331	79343	79356	79368	79380	79393	79405	79417	79430	79442	1	2
57	79454	79466	79479	79491	79503	79515	79528	79540	79552	79564	79577	79589	2	5
58	79601	79613	79626	79638	79650	79662	79674	79687	79699	79711	79723	79735	3	7
59	79748	79760	79772	79784	79796	79808	79821	79833	79845	79857	79869	79881	4	10

TABLE 33.

Logarithms of Apparent Time or Horary Angle.

7 Hours.

M	0s	5s	10s	15s	20s	25s	30s	35s	40s	45s	50s	55s	Pro. pts.	
0	9·79893	79905	79918	79930	79942	79954	79966	79978	79990	80002	80014	80026	s	
1	80038	80050	80063	80075	80087	80099	80111	80123	80135	80147	80159	80171	1	2
2	80183	80195	80207	80219	80231	80243	80255	80267	80279	80291	80303	80315	2	5
3	80327	80338	80350	80362	80374	80386	80398	80410	80422	80434	80446	80458	3	7
4	80470	80482	80494	80505	80517	80529	80541	80553	80565	80577	80588	80600	4	9
5	9·80612	80624	80636	80648	80660	80671	80683	80695	80707	80719	80730	80742	s	
6	80754	80766	80778	80789	80801	80813	80825	80836	80848	80860	80872	80883	1	2
7	80895	80907	80919	80930	80942	80954	80966	80977	80989	81001	81012	81024	2	5
8	81036	81047	81059	81071	81082	81094	81106	81117	81129	81141	81152	81164	3	7
9	81176	81187	81199	81211	81222	81234	81245	81257	81269	81280	81292	81303	4	9
10	9·81315	81326	81338	81350	81361	81373	81384	81396	81407	81419	81430	81442	s	
11	81454	81465	81477	81488	81500	81511	81523	81534	81546	81557	81569	81580	1	2
12	81592	81603	81614	81626	81637	81649	81660	81672	81683	81695	81706	81717	2	5
13	81729	81740	81752	81763	81775	81786	81797	81809	81820	81831	81843	81854	3	7
14	81866	81877	81888	81900	81911	81922	81934	81945	51956	81968	81979	81990	4	9
15	9·82002	82013	82024	82036	82047	82058	82070	82081	82092	82103	82115	82126	s	
16	82137	82148	82160	82171	82182	82193	82205	82216	82227	82238	82250	82261	1	2
17	82273	82283	82294	82306	82317	82328	82339	82350	82362	82373	82384	82395	2	4
18	82406	82417	82429	82440	82451	82462	82473	82484	82495	82507	82518	82529	3	7
19	82540	82551	82562	82573	82584	82595	82606	82618	82629	82640	82651	82662	4	9
20	9·82673	82684	82695	82706	82717	82728	82739	82750	82761	82772	82783	82794	s	
21	82805	82816	82827	82838	82849	82860	82871	82882	82893	82904	82915	82926	1	2
22	82937	82948	82959	82970	82981	82992	83003	83014	83025	83035	83046	83057	2	4
23	83068	83079	83090	83101	83112	83123	83134	83144	83155	83166	83177	83188	3	7
24	83199	83210	83220	83231	83242	83253	83264	83275	83285	83296	83307	83318	4	9
25	9·83329	83339	83350	83361	83372	83383	83393	83404	83415	83426	83436	83447	s	
26	83458	83469	83479	83490	83501	83512	83522	83533	83544	83555	83565	83576	1	2
27	83587	83597	83608	83619	83629	83640	83651	83662	83672	83683	83694	83704	2	4
28	83715	83725	83736	83747	83757	83768	83779	83789	83800	83811	83821	83832	3	7
29	83842	83853	83864	83874	83885	83895	83906	83916	83927	83938	83948	83959	4	9
30	9·83969	83980	83990	84001	84011	84022	84033	84043	84054	84064	84075	84085	s	
31	84096	84106	84117	84127	84138	84148	84159	84169	84179	84190	84200	84211	1	2
32	84221	84232	84242	84253	84263	84274	84284	84294	84305	84315	84326	84336	2	4
33	84346	84357	84367	84378	84388	84398	84409	84419	84430	84440	84450	84461	3	6
34	84471	84481	84492	84502	84512	84523	84533	84543	84554	84564	84574	84585	4	8
35	9·84595	84605	84616	84626	84636	84646	84657	84667	84677	84687	84698	84708	s	
36	84718	84729	84739	84749	84759	84769	84780	84790	84800	84810	84821	84831	1	2
37	84841	84851	84861	84872	84882	84892	84902	84912	84923	84933	84943	84953	2	4
38	84963	84973	84984	84994	85004	85014	85024	85034	85044	85054	85065	85075	3	6
39	85085	85095	85105	85115	85125	85135	85145	85155	85166	85176	85186	85196	4	8
40	9·85206	85216	85226	85236	85246	85256	85266	85276	85286	85296	85306	85316	s	
41	85326	85336	85346	85356	85366	85376	85386	85396	85406	85416	85426	85436	1	2
42	85446	85456	85466	85476	85486	85496	85506	85516	85526	85536	85546	85555	2	4
43	85565	85575	85585	85595	85605	85615	85625	85635	85645	85654	85664	85674	3	6
44	85684	85694	85704	85714	85724	85733	85743	85753	85763	85773	85783	85792	4	8
45	9·85802	85812	85822	85832	85841	85851	85861	85871	85881	85890	85900	85910	s	
46	85920	85930	85939	85949	85959	85969	85978	85988	85998	86008	86017	86027	1	2
47	86037	86046	86056	86066	86076	86085	86095	86105	86114	86124	86134	86143	2	4
48	86153	86163	86172	86182	86192	86201	86211	86221	86230	86240	86250	86259	3	6
49	86269	86279	86288	86298	86307	86317	86327	86336	86346	86356	86365	86375	4	8
50	9·86384	86394	86403	86413	86423	86432	86442	86451	86461	86470	86480	86489	s	
51	86499	86509	86518	86528	86537	86547	86556	86566	86575	86585	86594	86604	1	2
52	86613	86623	86632	86642	86651	86661	86670	86679	86689	86698	86708	86717	2	4
53	86727	86736	86746	86755	86764	96774	86783	86793	86802	86812	86821	86830	3	6
54	86840	86849	86858	86868	86877	86887	86896	86905	86915	86924	86933	86943	4	8
55	9·86952	86962	86971	86980	86990	86999	87008	87018	87027	87036	87045	87055	s	
56	87064	87073	87083	87092	87101	87111	87120	87129	87138	87148	87157	87166	1	2
57	87175	87185	87194	87203	87212	87222	87231	87240	87249	87259	87268	87277	2	4
58	87286	87295	87305	87314	87323	87332	87341	87351	87360	87369	87378	87387	3	6
59	87396	87406	87415	87424	87433	87442	87451	87460	87470	87479	87488	87497	4	8

TABLE 33.

Logarithms of Apparent Time, or Horary Angle.

8 Hours.

M	0s	5s	10s	15s	20s	25s	30s	35s	40s	45s	50s	55s	Pro. pts.	
0	9·87506	87515	87524	87534	87543	87552	87561	87570	87579	87588	87597	87606	s	
1	87615	87624	87633	87643	87652	87661	87670	87679	87688	87697	87706	87715	1	2
2	87724	87733	87742	87751	87760	87769	87778	87787	87796	87805	87814	87823	2	4
3	87832	87841	87850	87859	87868	87877	87886	87895	87904	87913	87921	87930	3	5
4	87939	87948	87957	87966	87975	87984	87993	88002	88011	88020	88029	88038	4	7
5	9·88046	88055	88064	88073	88082	88091	88100	88109	88117	88126	88135	88144	s	
6	88153	88162	88170	88179	88188	88197	88206	88215	88223	88232	88241	88250	1	2
7	88259	88268	88276	88285	88294	88303	88311	88320	88329	88338	88346	88355	2	4
8	88364	88373	88381	88390	88399	88408	88416	88425	88434	88443	88451	88460	3	5
9	88469	88478	88486	88495	88503	88512	88521	88530	88538	88547	88556	88565	4	7
10	9·88573	88582	88590	88599	88607	88616	88625	88634	88642	88651	88659	88668	s	
11	88677	88686	88694	88703	88711	88720	88728	88737	88745	88754	88763	88772	1	2
12	88780	88789	88797	88806	88814	88823	88831	88840	88848	88857	88865	88874	2	4
13	88882	88891	88899	88908	88916	88925	88933	88942	88950	88959	88967	88976	3	5
14	88984	88993	89001	89010	89018	89027	89035	89044	89052	89061	89069	89078	4	7
15	9·89086	89095	89103	89112	89120	89129	89137	89145	89153	89162	89170	89179	s	
16	89187	89196	89204	89213	89221	89229	89237	89246	89254	89263	89271	89279	1	2
17	89287	89296	89304	89313	89321	89330	89338	89346	89354	89363	89371	89379	2	4
18	89387	89396	89404	89413	89421	89429	89437	89446	89454	89462	89470	89479	3	5
19	89487	89495	89503	89512	89520	89528	89536	89545	89553	89561	89569	89577	4	7
20	9·89586	89594	89602	89611	89619	89627	89635	89643	89651	89660	89668	89676	s	
21	89684	89693	89701	89709	89717	89725	89733	89741	89749	89758	89766	89774	1	2
22	89782	89790	89798	89807	89815	89823	89831	89839	89847	89855	89863	89871	2	3
23	89879	89888	89896	89904	89912	89920	89928	89936	89944	89952	89960	89968	3	5
24	89976	89984	89992	90000	90008	90016	90024	90032	90040	90048	90056	90064	4	6
25	9·90072	90080	90088	90096	90104	90112	90120	90128	90136	90144	90152	90160	s	
26	90168	90176	90184	90192	90200	90208	90216	90224	90232	90240	90248	90256	1	2
27	90263	90271	90279	90287	90295	90303	90311	90319	90327	90335	90342	90350	2	3
28	90358	90366	90374	90382	90390	90398	90405	90413	90421	90429	90437	90445	3	5
29	90452	90460	90468	90476	90484	90492	90499	90507	90515	90523	90531	90539	4	6
30	9·90546	90554	90562	90570	90577	90585	90593	90601	90608	90616	90624	90632	s	
31	90639	90647	90655	90663	90670	90678	90686	90694	90701	90709	90717	90725	1	2
32	90732	90740	90747	90755	90763	90771	90778	90786	90794	90802	90809	90817	2	3
33	90824	90832	90840	90848	90855	90863	90870	90878	90885	90893	90901	90909	3	5
34	90916	90924	90931	90939	90946	90954	90962	90970	90977	90985	90992	91000	4	6
35	9·91007	91015	91022	91030	91037	91045	91052	91060	91067	91075	91083	91091	s	
36	91098	91106	91113	91121	91128	91136	91143	91151	91158	91166	91173	91181	1	2
37	91188	91196	91203	91211	91218	91226	91233	91241	91248	91255	91262	91270	2	3
38	91277	91285	91292	91300	91307	91315	91322	91330	91337	91345	91352	91360	3	5
39	91367	91374	91381	91389	91396	91404	91411	91419	91426	91433	91440	91448	4	6
40	9·91455	91463	91470	91478	91485	91492	91499	91507	91514	91522	91529	91536	s	
41	91543	61551	91558	91566	91573	91580	91587	91595	91602	91609	91616	91624	1	2
42	91631	91638	91645	91653	91660	91667	91674	91682	91689	91696	91703	91711	2	3
43	91718	91725	91732	91740	91747	91754	91761	91769	91776	91783	91790	91798	3	5
44	91805	91812	91819	91826	91833	91841	91848	91855	91862	91869	91876	91884	4	6
45	9·91891	91898	91905	91912	91919	91927	91934	91941	91948	91955	91962	91969	s	
46	91976	91984	91991	91998	92005	92012	92019	92026	92033	92040	92047	92054	1	1
47	92061	92069	92076	92083	92090	92097	92104	92111	92118	92125	92132	92139	2	3
48	92146	92153	92160	92167	92174	92181	92188	92195	92202	92209	92216	92223	3	4
49	92230	92237	92244	92251	92258	92265	92272	92279	92286	92293	92300	92307	4	6
50	9·92314	92321	92328	92335	92342	92349	92355	92362	92369	92376	92383	92390	s	
51	92397	92404	92411	92418	92425	92432	92438	92445	92452	92459	92466	92473	1	1
52	92480	92487	92493	92500	92507	92514	92521	92528	92534	92541	92548	92555	2	3
53	92562	92569	92575	92582	92589	92596	92603	92610	92616	92623	92630	92637	3	4
54	92643	92650	92657	92664	92670	92677	92684	92691	92698	92705	92711	92718	4	6
55	9·92725	92732	92738	92745	92751	92758	92765	92772	92778	92785	92792	92799	s	
56	32805	92812	92819	92826	92832	92839	92845	92852	92859	92866	92872	92879	1	1
57	92885	92892	92899	92906	92912	92919	92925	92932	92939	92946	92952	92959	2	3
58	92965	92972	92978	92985	92992	92999	93005	93012	93018	93025	93031	93038	3	4
59	93044	93051	93057	93064	93071	93078	93084	93091	93097	93104	93110	93117	4	6

TABLE 34

Logarithms of the Apparent Altitudes and Horizontal Parallax.

	Apparent Altitude 5°									Apparent Altitude 6°									
	Moon's Horizontal Parallax.									Moon's Horizontal Parallax.									′ or ″
′	53′	54′	55′	56′	57′	58′	59′	60′	61′	53′	54′	55′	56′	57′	58′	59′	60′	61′	
0	1·5907	5826	5746	5668	5591	5515	5441	5368	5296	1·5118	5037	4957	4879	4802	4726	4652	4579	4507	0
1	1·5893	5812	5732	5654	5577	5501	5427	5354	5282	1·5106	5025	4945	4867	4790	4714	4640	4567	4495	1
2	1·5878	5797	5717	5639	5562	5486	5412	5339	5267	1·5094	5013	4933	4855	4778	4702	4628	4555	4483	2
3	1·5864	5783	5703	5625	5548	5472	5398	5325	5253	1·5082	5001	4921	4843	4766	4690	4616	4543	4471	3
4	1·5850	5769	5689	5611	5534	5458	5384	5311	5239	1·5070	4989	4909	4831	4754	4678	4604	4531	4459	4
5	1·5835	5754	5674	5596	5519	5443	5369	5296	5224	1·5058	4977	4897	4819	4742	4666	4592	4519	4447	5
6	1·5821	5740	5660	5582	5505	5429	5355	5282	5210	1·5046	4965	4885	4807	4730	4654	4580	4507	4435	6
7	1·5807	5726	5646	5568	5491	5415	5341	5268	5196	1·5034	4953	4873	4795	4718	4642	4568	4495	4423	7
8	1·5793	5712	5632	5554	5477	5401	5327	5254	5182	1·5023	4942	4862	4784	4707	4631	4557	4484	4412	8
9	1·5779	5698	5618	5540	5463	5387	5313	5240	5178	1·5011	4930	4850	4772	4695	4619	4545	4471	4399	9
10	1·5765	5684	5604	5526	5449	5373	5299	5226	5164	1·4999	4918	4838	4760	4683	4607	4533	4460	4388	10
11	1·5751	5670	5590	5512	5435	5359	5285	5212	5150	1·4987	4906	4826	4748	4671	4595	4521	4448	4376	11
12	1·5737	5656	5576	5498	5421	5345	5271	5198	5136	1·4975	4894	4814	4736	4659	4583	4509	4436	4364	12
13	1·5723	5642	5562	5484	5407	5331	5257	5184	5112	1·4964	4883	4803	4725	4648	4572	4498	4425	4353	13
14	1·5709	5628	5548	5470	5393	5317	5243	5170	5098	1·4953	4872	4792	4714	4637	4561	4487	4414	4342	14
15	1·5696	5615	5535	5457	5380	5304	5230	5157	5085	1·4941	4860	4780	4702	4625	4549	4475	4402	4330	15
16	1·5682	5601	5521	5443	5366	5290	5216	5143	5071	1·4930	4849	4769	4691	4614	4538	4464	4391	4319	16
17	1·5668	5587	5507	5429	5352	5276	5202	5129	5057	1·4918	4837	4757	4679	4602	4526	4452	4379	4307	17
18	1·5655	5574	5494	5416	5339	5263	5189	5116	5044	1·4907	4826	4746	4668	4591	4515	4441	4368	4296	18
19	1·5641	5560	5480	5402	5325	5249	5175	5102	5030	1·4895	4814	4734	4656	4579	4503	4429	4356	4284	19
20	1·5628	5547	5467	5389	5312	5236	5162	5089	5017	1·4884	4803	4723	4645	4568	4492	4418	4345	4273	20
21	1·5614	5533	5453	5375	5298	5222	5148	5075	5003	1·4872	4791	4711	4633	4556	4480	4406	4333	4261	21
22	1·5601	5520	5440	5362	5285	5209	5135	5062	4990	1·4861	4780	4700	4622	4545	4469	4395	4322	4250	22
23	1·5587	5506	5426	5348	5271	5195	5121	5048	4976	1·4850	4769	4689	4611	4534	4458	4384	4311	4239	23
24	1·5574	5493	5413	5335	5258	5182	5108	5035	4963	1·4838	4757	4677	4599	4522	4446	4372	4299	4227	24
25	1·5560	5479	5399	5321	5243	5167	5093	5020	4948	1·4827	4746	4666	4588	4511	4435	4361	4288	4216	25
26	1·5547	5466	5386	5308	5231	5155	5081	5008	4936	1·4816	4735	4655	4577	4500	4424	4350	4277	4205	26
27	1·5534	5453	5373	5295	5218	5142	5068	4995	4923	1·4805	4724	4644	4566	4489	4413	4339	4266	4194	27
28	1·5521	5440	5360	5282	5205	5129	5055	4982	4910	1·4794	4713	4633	4555	4478	4402	4328	4255	4183	28
29	1·5507	5426	5346	5268	5191	5115	5041	4968	4896	1·4783	4702	4622	4544	4467	4391	4317	4244	4172	29
30	1·5494	5413	5333	5255	5178	5102	5028	4955	4883	1·4771	4690	4610	4532	4455	4379	4305	4232	4160	30
31	1·5481	5400	5320	5242	5165	5089	5015	4942	4870	1·4760	4679	4599	4521	4444	4368	4294	4221	4149	31
32	1·5468	5387	5307	5229	5152	5076	5002	4929	4857	1·4749	4668	4588	4510	4433	4357	4283	4210	4138	32
33	1·5455	5374	5294	5216	5139	5063	4989	4916	4844	1·4738	4657	4577	4499	4422	4346	4272	4199	4127	33
34	1·5442	5361	5281	5203	5126	5050	4976	4903	4831	1·4727	4646	4566	4488	4411	4335	4261	4188	4116	34
35	1·5429	5348	5268	5190	5113	5037	4963	4890	4818	1·4716	4635	4555	4477	4400	4324	4250	4177	4105	35
36	1·5416	5335	5255	5177	5100	5024	4950	4877	4805	1·4705	4624	4544	4466	4389	4313	4239	4166	4094	36
37	1·5403	5322	5242	5164	5087	5011	4937	4864	4792	1·4694	4613	4533	4455	4378	4302	4228	4155	4083	37
38	1·5391	5310	5230	5152	5075	4999	4925	4852	4780	1·4684	4603	4523	4445	4368	4292	4218	4145	4073	38
39	1·5378	5297	5217	5139	5062	4986	4912	4839	4767	1·4673	4592	4512	4434	4357	4281	4207	4134	4062	39
40	1·5365	5284	5204	5126	5049	4973	4901	4828	4756	1·4662	4581	4501	4423	4346	4270	4196	4123	4051	40
41	1·5352	5271	5191	5113	5036	4960	4886	4813	4741	1·4651	4570	4490	4412	4335	4259	4185	4112	4040	41
42	1·5340	5259	5179	5101	5024	4948	4874	4801	4729	1·4640	4559	4479	4402	4324	4248	4174	4101	4029	42
43	1·5327	5246	5166	5088	5011	4935	4861	4788	4716	1·4630	4549	4469	4391	4314	4238	4164	4091	4019	43
44	1·5314	5233	5153	5075	4998	4922	4848	4775	4703	1·4619	4538	4458	4380	4303	4227	4153	4080	4008	44
45	1·5302	5221	5141	5063	4986	4910	4836	4763	4691	1·4608	4527	4447	4369	4292	4216	4142	4069	3997	45
46	1·5289	5208	5128	5050	4973	4897	4823	4750	4678	1·4598	4517	4437	4359	4282	4206	4132	4059	3987	46
47	1·5277	5196	5116	5038	4961	4885	4811	4738	4666	1·4587	4506	4426	4348	4271	4195	4121	4048	3976	47
48	1·5264	5183	5103	5025	4948	4872	4798	4725	4653	1·4576	4495	4415	4337	4260	4184	4110	4037	3965	48
49	1·5252	5171	5091	5013	4936	4860	4786	4713	4641	1·4566	4485	4405	4327	4250	4174	4100	4027	3955	49
50	1·5240	5159	5079	5001	4924	4848	4774	4701	4629	1·4555	4474	4394	4316	4239	4163	4089	4016	3944	50
51	1·5227	5146	5066	4988	4911	4835	4761	4688	4616	1·4545	4464	4384	4306	4229	4153	4079	4006	3934	51
52	1·5215	5134	5054	4976	4899	4823	4749	4676	4604	1·4534	4453	4373	4295	4218	4142	4068	3995	3923	52
53	1·5203	5122	5042	4964	4887	4811	4737	4664	4592	1·4524	4443	4363	4285	4208	4132	4058	3985	3913	53
54	1·5190	5109	5029	4951	4874	4798	4724	4651	4579	1·4513	4432	4352	4274	4197	4121	4047	3974	3902	54
55	1·5178	5097	5017	4939	4862	4786	4712	4639	4567	1·4503	4422	4342	4264	4187	4111	4037	3964	3892	55
56	1·5166	5085	5005	4927	4850	4774	4700	4627	4555	1·4492	4411	4331	4253	4176	4100	4026	3953	3881	56
57	1·5154	5073	4993	4915	4838	4762	4688	4615	4543	1·4482	4401	4321	4243	4166	4090	4016	3943	3871	57
58	1·5142	5061	4981	4903	4826	4750	4676	4603	4531	1·4472	4391	4311	4233	4156	4080	4006	3933	3861	58
59	1·5130	5049	4969	4891	4814	4738	4664	4591	4519	1·4461	4380	4300	4222	4145	4069	3995	3922	3850	59
	53′	54′	55′	56′	57′	58′	59′	60′	61′	53′	54′	55′	56	57′	58′	59′	60′	61′	

TABLE 34

Logarithms of the Apparent Altitudes and Horizontal Parallax.

Apparent Altitude 7°									Apparent Altitude 8°									′ or ″	P.P. to ″ of Par.
Moon's Horizontal Parallax.									Moon's Horizontal Parallax.										
53′	54′	55′	56′	57′	58′	59′	60′	61′	53′	54′	55′	56′	57′	58′	59′	60′	61′		
1 ·4451	4370	4290	4212	4135	4059	3985	3912	3840	1 ·3874	3793	3713	3635	3558	3482	3408	3335	3263	0	—0
1 ·4441	4360	4280	4202	4125	4049	3975	3902	3830	1 ·3865	3784	3704	3626	3549	3473	3399	3326	3254	1	1
1 ·4431	4350	4270	4192	4115	4039	3965	3892	3820	1 ·3857	3776	3696	3618	3541	3465	3391	3318	3246	2	3
1 ·4420	4339	4259	4181	4104	4028	3954	3881	3809	1 ·3848	3767	3687	3609	3532	3456	3382	3309	3237	3	4
1 ·4410	4329	4249	4171	4094	4018	3944	3871	3799	1 ·3839	3758	3678	3600	3523	3447	3373	3300	3228	4	5
1 ·4400	4319	4239	4161	4084	4008	3934	3861	3789	1 ·3830	3749	3669	3591	3514	3438	3364	3291	3219	5	6
1 ·4390	4309	4229	4151	4074	3998	3924	3851	3779	1 ·3821	3740	3660	3582	3505	3429	3355	3282	3210	6	8
1 ·4380	4299	4219	4141	4064	3988	3914	3841	3769	1 ·3812	3731	3651	3573	3496	3420	3346	3273	3201	7	9
1 ·4370	4289	4209	4131	4054	3978	3904	3831	3759	1 ·3803	3722	3642	3564	3487	3411	3337	3264	3192	8	10
1 ·4359	4278	4198	4120	4043	3967	3893	3820	3748	1 ·3794	3713	3633	3555	3478	3402	3328	3255	3183	9	11
1 ·4349	4268	4188	4110	4033	3957	3883	3810	3738	1 ·3785	3704	3624	3546	3469	3393	3319	3246	3174	10	13
1 ·4339	4258	4178	4100	4023	3947	3873	3800	3728	1 ·3777	3696	3616	3538	3461	3385	3311	3238	3166	11	14
1 ·4329	4248	4168	4090	4013	3937	3863	3790	3718	1 ·3768	3687	3607	3529	3452	3376	3302	3229	3157	12	15
1 ·4319	4238	4158	4080	4003	3927	3853	3780	3708	1 ·3759	3678	3598	3520	3443	3367	3293	3220	3148	13	17
1 ·4309	4228	4148	4070	3993	3917	3843	3770	3698	1 ·3750	3669	3589	3511	3434	3358	3284	3211	3139	14	18
1 ·4299	4218	4138	4060	3983	3907	3833	3760	3688	1 ·3742	3661	3581	3503	3426	3350	3276	3203	3131	15	19
1 ·4290	4209	4129	4051	3974	3898	3824	3751	3679	1 ·3733	3652	3572	3494	3417	3341	3267	3194	3122	16	20
1 ·4280	4199	4119	4041	3964	3888	3814	3741	3669	1 ·3724	3643	3563	3485	3408	3332	3258	3185	3113	17	22
1 ·4270	4189	4109	4031	3954	3878	3804	3731	3659	1 ·3716	3635	3555	3477	3400	3324	3250	3177	3105	18	23
1 ·4260	4179	4099	4021	3944	3868	3794	3721	3649	1 ·3707	3626	3546	3468	3391	3315	3241	3168	3096	19	24
1 ·4250	4169	4089	4011	3934	3858	3784	3711	3639	1 ·3698	3617	3537	3459	3382	3306	3232	3159	3087	20	25
1 ·4240	4159	4079	4001	3924	3848	3774	3701	3629	1 ·3690	3609	3529	3451	3374	3298	3224	3151	3079	21	27
1 ·4230	4149	4069	3991	3914	3838	3764	3691	3619	1 ·3681	3600	3520	3442	3365	3289	3215	3142	3070	22	28
1 ·4221	4140	4060	3982	3905	3829	3755	3682	3610	1 ·3673	3592	3512	3434	3357	3281	3207	3134	3062	23	29
1 ·4211	4130	4050	3972	3895	3819	3745	3672	3600	1 ·3664	3583	3503	3425	3348	3272	3198	3125	3053	24	30
1 ·4201	4120	4040	3962	3885	3809	3735	3662	3590	1 ·3655	3574	3494	3416	3339	3263	3189	3116	3044	25	32
1 ·4192	4111	4031	3953	3876	3800	3726	3653	3581	1 ·3647	3566	3486	3408	3331	3255	3181	3108	3036	26	33
1 ·4182	4101	4021	3943	3866	3790	3716	3643	3571	1 ·3638	3557	3477	3399	3322	3246	3172	3099	3027	27	34
1 ·4172	4091	4011	3933	3856	3780	3706	3633	3561	1 3630	3549	3469	3391	3314	3238	3164	3091	3019	28	35
1 ·4163	4082	4002	3924	3847	3771	3697	3624	3552	1 ·3621	3540	3460	3382	3305	3229	3155	3082	3010	29	37
1 ·4153	4072	3992	3914	3837	3761	3687	3614	3542	1 ·3613	3532	3452	3374	3297	3221	3147	3074	3002	30	38
1 ·4143	4062	3982	3904	3827	3751	3677	3604	3532	1 ·3604	3523	3443	3365	3288	3212	3138	3065	2993	31	39
1 ·4134	4053	3973	3895	3818	3742	3668	3595	3523	1 ·3596	3515	3435	3357	3279	3203	3129	3056	2984	32	41
1 ·4124	4043	3963	3885	3808	3732	3658	3585	3513	1 ·3588	3507	3427	3349	3272	3196	3122	3049	2977	33	42
1 ·4115	4034	3954	3876	3799	3723	3649	3576	3504	1 ·3579	3498	3418	3340	3263	3187	3113	3040	2968	34	43
1 ·4105	4024	3944	3866	3789	3713	3639	3566	3494	1 ·3571	3490	3410	3332	3255	3179	3105	3032	2960	35	44
1 ·4096	4015	3935	3857	3780	3704	3630	3557	3485	1 ·3563	3482	3402	3324	3247	3171	3097	3024	2952	36	45
1 ·4086	4005	3925	3847	3770	3694	3620	3547	3475	1 ·3554	3473	3393	3315	3238	3162	3088	3015	2943	37	47
1 ·4077	3996	3916	3838	3761	3685	3611	3538	3466	1 ·3546	3465	3385	3307	3230	3154	3080	3007	2935	38	48
1 ·4068	3987	3907	3829	3752	3676	3602	3529	3457	1 ·3538	3457	3377	3299	3222	3146	3072	2999	2927	39	49
1 ·4058	3977	3897	3819	3742	3666	3592	3519	3447	1 ·3529	3448	3368	3290	3213	3137	3063	2990	2918	40	51
1 ·4049	3968	3888	3810	3733	3657	3583	3510	3438	1 ·3521	3440	3360	3282	3205	3129	3055	2982	2910	41	52
1 ·4039	3958	3878	3800	3723	3647	3573	3500	3428	1 3513	3432	3352	3274	3197	3121	3047	2974	2902	42	53
1 ·4030	3949	3869	3791	3714	3638	3564	3491	3419	1 ·3504	3423	3343	3265	3188	3112	3038	2965	2893	43	54
1 ·4021	3940	3860	3782	3705	3629	3555	3482	3410	1 ·3496	3415	3335	3257	3180	3104	3030	2957	2885	44	56
1 ·4011	3930	3850	3772	3695	3619	3545	3472	3400	1 ·3488	3407	3327	3249	3172	3096	3022	2949	2877	45	57
1 ·4002	3921	3841	3763	3686	3610	3536	3463	3391	1 ·3480	3399	3319	3241	3164	3088	3014	2941	2869	46	58
1 ·3993	3912	3832	3754	3677	3601	3527	3454	3382	1 ·3472	3391	3311	3233	3156	3080	3006	2933	2861	47	59
1 ·3984	3903	3823	3745	3668	3592	3518	3445	3373	1 ·3463	3382	3302	3224	3147	3071	2997	2924	2852	48	61
1 ·3974	3893	3813	3735	3658	3582	3508	3435	3363	1 ·3455	3374	3294	3216	3139	3063	2989	2916	2844	49	62
1 ·3965	3884	3804	3726	3649	3573	3499	3426	3354	1 ·3447	3366	3286	3208	3131	3055	2981	2908	2836	50	63
1 ·3956	3875	3795	3717	3640	3564	3490	3417	3345	1 ·3439	3358	3278	3200	3123	3047	2973	2900	2828	51	64
1 ·3947	3866	3786	3708	3631	3555	3481	3408	3336	1 ·3431	3350	3270	3192	3115	3039	2965	2892	2820	52	66
1 ·3938	3857	3777	3699	3622	3546	3472	3399	3327	1 ·3423	3342	3262	3184	3107	3031	2957	2884	2812	53	67
1 ·3929	3848	3768	3690	3613	3537	3463	3390	3318	1 ·3415	3334	3254	3176	3099	3023	2949	2876	2804	54	68
1 ·3920	3839	3759	3681	3604	3528	3454	3381	3309	1 ·3407	3326	3246	3168	3091	3015	2941	2868	2796	55	69
1 ·3911	3830	3750	3672	3595	3519	3445	3372	3300	1 ·3399	3318	3238	3160	3083	3007	2933	2860	2788	56	71
1 ·3901	3820	3740	3662	3585	3509	3435	3362	3290	1 ·3391	3310	3230	3152	3075	2999	2925	2852	2780	57	72
1 ·3892	3811	3731	3653	3576	3500	3426	3353	3281	1 ·3383	3302	3222	3144	3067	2991	2917	2844	2772	58	73
1 ·3883	3802	3722	3644	3567	3491	3417	3344	3272	1 ·3375	3294	3214	3136	3059	2983	2909	2836	2764	59	74
53′	54′	55′	56′	57′	58′	59′	60′	61′	53′	54′	55′	56′	57′	58′	59′	60′	61′		

TABLE 34

Logarithms of the Apparent Altitudes and Horizontal Parallax.

	Apparent Altitude 9°									Apparent Altitude 10°									
	Moon's Horizontal Parallax.									Moon's Horizontal Parallax.									′ or ″
′	53′	54′	55′	56′	57′	58′	59′	60′	61′	53′	54′	55′	56′	57′	58′	59′	60′	61′	
0	1·3367	3286	3206	3128	3051	2975	2901	2828	2756	1·2913	2832	2752	2674	2597	2521	2447	2374	2302	0
1	1·3359	3278	3198	3120	3043	2967	2893	2820	2748	1·2906	2825	2745	2667	2590	2514	2440	2367	2295	1
2	1·3351	3270	3190	3112	3035	2959	2885	2812	2740	1·2899	2818	2738	2660	2583	2507	2433	2360	2288	2
3	1·3343	3262	3182	3104	3027	2951	2877	2804	2732	1·2892	2811	2731	2653	2576	2500	2426	2353	2281	3
4	1·3335	3254	3174	3096	3019	2943	2869	2796	2724	1·2885	2804	2724	2646	2569	2493	2419	2346	2274	4
5	1·3327	3246	3166	3088	3011	2935	2861	2788	2716	1·2878	2797	2717	2639	2562	2486	2412	2339	2267	5
6	1·3319	3238	3158	3080	3003	2927	2853	2780	2708	1·2871	2790	2710	2632	2555	2479	2405	2332	2260	6
7	1·3311	3230	3150	3072	2995	2919	2845	2772	2700	1·2863	2782	2702	2624	2547	2471	2397	2324	2252	7
8	1·3303	3222	3142	3064	2987	2911	2837	2764	2692	1·2856	2775	2695	2617	2540	2464	2390	2317	2245	8
9	1·3295	3214	3134	3056	2979	2903	2829	2756	2684	1·2849	2768	2688	2610	2533	2457	2383	2310	2238	9
10	1·3288	3207	3127	3049	2972	2896	2822	2749	2677	1·2842	2761	2681	2603	2526	2450	2376	2303	2231	10
11	1·3280	3199	3119	3041	2964	2888	2814	2741	2669	1·2835	2754	2674	2596	2519	2443	2369	2296	2224	11
12	1·3272	3191	3111	3033	2956	2880	2806	2733	2661	1·2828	2747	2667	2589	2512	2436	2362	2289	2217	12
13	1·3264	3183	3103	3025	2948	2872	2798	2725	2653	1·2821	2740	2660	2582	2505	2429	2355	2282	2210	13
14	1·3256	3175	3095	3017	2940	2864	2790	2717	2645	1·2814	2733	2653	2575	2498	2422	2348	2275	2203	14
15	1·3249	3168	3088	3010	2933	2857	2783	2710	2638	1·2807	2726	2646	2568	2491	2415	2341	2268	2196	15
16	1·3241	3160	3080	3002	2925	2849	2775	2702	2630	1·2800	2719	2639	2561	2484	2408	2334	2261	2189	16
17	1·3233	3152	3072	2994	2917	2841	2767	2694	2622	1·2793	2712	2632	2554	2477	2401	2327	2254	2182	17
18	1·3225	3144	3064	2986	2909	2833	2759	2686	2614	1·2786	2705	2625	2547	2470	2394	2320	2247	2175	18
19	1·3218	3137	3057	2979	2902	2826	2752	2679	2607	1·2779	2698	2618	2540	2463	2387	2313	2240	2168	19
20	1·3210	3129	3049	2971	2894	2818	2744	2671	2599	1·2772	2691	2611	2533	2456	2380	2306	2233	2161	20
21	1·3202	3121	3041	2963	2886	2810	2736	2663	2591	1·2765	2684	2604	2526	2449	2373	2299	2226	2154	21
22	1·3195	3114	3034	2956	2879	2803	2729	2656	2584	1·2759	2678	2598	2520	2443	2367	2293	2220	2148	22
23	1·3187	3106	3026	2948	2871	2795	2721	2648	2576	1·2752	2671	2591	2513	2436	2360	2286	2213	2141	23
24	1·3179	3098	3018	2940	2863	2787	2713	2640	2568	1·2745	2664	2584	2506	2429	2353	2279	2206	2134	24
25	1·3172	3091	3011	2933	2856	2780	2706	2633	2561	1·2738	2657	2577	2499	2422	2346	2272	2199	2127	25
26	1·3164	3083	3003	2925	2848	2772	2698	2625	2553	1·2731	2650	2570	2492	2415	2339	2265	2192	2120	26
27	1·3157	3076	2996	2918	2841	2765	2691	2618	2546	1·2724	2643	2563	2485	2408	2332	2258	2185	2113	27
28	1·3149	3068	2988	2910	2833	2757	2683	2610	2538	1·2717	2636	2556	2478	2401	2325	2251	2178	2106	28
29	1·3141	3060	2980	2902	2825	2749	2675	2602	2530	1·2710	2629	2549	2471	2394	2318	2244	2171	2099	29
30	1·3134	3053	2973	2895	2818	2742	2668	2595	2523	1·2704	2623	2543	2465	2388	2312	2238	2165	2093	30
31	1·3126	3045	2965	2887	2810	2734	2660	2587	2515	1·2697	2616	2536	2458	2381	2305	2231	2158	2086	31
32	1·3119	3038	2958	2880	2803	2727	2653	2580	2508	1·2690	2609	2529	2451	2374	2298	2224	2151	2079	32
33	1·3111	3030	2950	2872	2795	2719	2645	2572	2500	1·2683	2602	2522	2444	2367	2291	2217	2144	2072	33
34	1·3104	3023	2943	2865	2788	2712	2638	2565	2493	1·2676	2595	2515	2437	2360	2284	2210	2137	2065	34
35	1·3096	3015	2935	2857	2780	2704	2630	2557	2485	1·2670	2589	2509	2431	2354	2278	2204	2131	2059	35
36	1·3089	3008	2928	2850	2773	2697	2623	2550	2478	1·2663	2582	2502	2424	2347	2271	2197	2124	2052	36
37	1·3081	3000	2920	2842	2765	2689	2615	2542	2470	1·2656	2575	2495	2417	2340	2264	2190	2117	2045	37
38	1·3074	2993	2913	2835	2758	2682	2608	2535	2463	1·2649	2568	2488	2410	2333	2257	2183	2110	2038	38
39	1·3067	2986	2906	2828	2751	2675	2601	2528	2456	1·2643	2562	2482	2404	2327	2251	2177	2104	2032	39
40	1·3059	2978	2898	2820	2743	2667	2593	2520	2448	1·2636	2555	2475	2397	2320	2244	2170	2097	2025	40
41	1·3052	2971	2891	2813	2736	2660	2586	2513	2441	1·2629	2548	2468	2390	2313	2237	2163	2090	2018	41
42	1·3044	2963	2883	2805	2728	2652	2578	2505	2433	1·2623	2542	2462	2384	2307	2231	2157	2084	2012	42
43	1·3037	2956	2876	2798	2721	2645	2571	2498	2426	1·2616	2535	2455	2377	2300	2224	2150	2077	2005	43
44	1·3030	2949	2869	2791	2714	2638	2564	2491	2419	1·2609	2528	2448	2370	2293	2217	2143	2070	1998	44
45	1·3022	2941	2861	2783	2706	2630	2556	2483	2411	1·2603	2522	2442	2364	2287	2211	2137	2064	1992	45
46	1·3015	2934	2854	2776	2699	2623	2549	2475	2403	1·2596	2515	2435	2357	2280	2204	2130	2057	1985	46
47	1·3007	2926	2846	2768	2691	2615	2541	2468	2396	1·2589	2508	2428	2350	2273	2197	2123	2050	1978	47
48	1·3000	2919	2839	2761	2684	2608	2534	2461	2389	1·2583	2502	2422	2344	2267	2191	2117	2044	1972	48
49	1·2993	2912	2832	2754	2677	2601	2527	2454	2382	1·2576	2495	2415	2337	2260	2184	2110	2037	1965	49
50	1·2986	2905	2825	2747	2670	2594	2520	2447	2375	1·2570	2489	2409	2331	2254	2178	2104	2031	1959	50
51	1·2978	2897	2817	2739	2662	2586	2512	2439	2367	1·2563	2482	2402	2324	2247	2171	2097	2024	1952	51
52	1·2971	2890	2810	2732	2655	2579	2505	2432	2360	1·2556	2475	2395	2317	2240	2164	2090	2017	1945	52
53	1·2964	2883	2803	2725	2648	2572	2498	2425	2353	1·2550	2469	2389	2311	2234	2158	2084	2011	1939	53
54	1·2957	2876	2796	2718	2641	2565	2491	2418	2346	1·2543	2462	2382	2304	2227	2151	2077	2004	1932	54
55	1·2949	2868	2788	2710	2633	2557	2483	2410	2338	1·2537	2456	2376	2298	2221	2145	2071	1998	1926	55
56	1·2942	2861	2781	2703	2626	2550	2476	2403	2331	1·2530	2449	2369	2291	2214	2138	2064	1991	1919	56
57	1·2935	2854	2774	2696	2619	2543	2469	2396	2324	1·2524	2443	2363	2285	2208	2132	2058	1985	1913	57
58	1·2928	2847	2767	2689	2612	2536	2462	2389	2317	1·2517	2436	2356	2278	2201	2125	2051	1978	1906	58
59	1·2920	2839	2759	2681	2604	2528	2454	2381	2309	1·2511	2430	2350	2272	2195	2119	2045	1972	1900	59
	53′	54′	55′	56′	57′	58′	59′	60′	61′	53′	54′	55′	56′	57′	58′	59′	60′	61	

TABLE 34

Logarithms of the Apparent Altitudes and Horizontal Parallax.

Apparent Altitude 11°									Apparent Altitude 12°									′ or ″	P.P. to ″ of Par.
Moon's Horizontal Parallax.									Moon's Horizontal Parallax.										
53′	54′	55′	56′	57′	58′	59′	60′	61′	53′	54′	55′	56′	57′	58′	59′	60′	61′		
1·2504	2423	2343	2265	2188	2112	2038	1965	1893	1·2131	2050	1970	1892	1815	1739	1665	1592	1520	0	—0
1·2498	2417	2337	2259	2182	2106	2032	1959	1887	1·2125	2044	1964	1886	1809	1733	1659	1586	1514	1	1
1·2491	2410	2330	2252	2174	2098	2024	1951	1880	1·2119	2038	1958	1880	1803	1727	1653	1580	1508	2	3
1·2485	2404	2324	2246	2169	2093	2019	1946	1874	1·2113	2032	1952	1874	1797	1721	1647	1574	1502	3	4
1·2478	2397	2317	2239	2162	2086	2012	1939	1867	1·2108	2027	1947	1869	1792	1716	1642	1569	1497	4	5
1·2472	2391	2311	2233	2156	2080	2006	1933	1861	1·2102	2021	1941	1863	1786	1710	1636	1563	1491	5	6
1·2465	2384	2304	2226	2149	2073	1999	1926	1854	1·2096	2015	1935	1857	1780	1704	1630	1557	1485	6	8
1·2459	2378	2298	2220	2143	2067	1993	1920	1848	1·2090	2009	1928	1850	1773	1697	1623	1550	1478	7	9
1·2452	2371	2291	2213	2136	2060	1986	1913	1841	1·2084	2003	1923	1845	1768	1692	1618	1545	1473	8	10
1·2446	2365	2285	2207	2130	2054	1980	1907	1835	1·2078	1997	1917	1839	1762	1686	1612	1539	1467	9	11
1·2440	2359	2279	2201	2124	2048	1974	1901	1829	1·2072	1991	1911	1833	1756	1680	1606	1533	1461	10	13
1·2433	2352	2272	2194	2117	2041	1967	1894	1822	1·2066	1985	1905	1827	1750	1674	1600	1527	1455	11	14
1·2427	2346	2266	2188	2111	2035	1961	1888	1816	1·2060	1979	1899	1821	1744	1668	1594	1521	1449	12	15
1·2420	2339	2259	2181	2104	2028	1954	1881	1809	1·2055	1974	1894	1816	1739	1663	1589	1516	1444	13	17
1·2414	2333	2253	2175	2098	2022	1948	1875	1803	1·2049	1968	1888	1810	1733	1657	1583	1510	1438	14	18
1·2408	2327	2247	2169	2092	2016	1942	1869	1797	1·2043	1962	1882	1804	1727	1651	1577	1504	1432	15	19
1·2401	2320	2240	2162	2085	2009	1935	1862	1790	1·2037	1956	1876	1798	1721	1645	1571	1498	1426	16	20
1·2395	2314	2234	2156	2079	2003	1929	1856	1784	1·2031	1950	1870	1792	1715	1639	1565	1492	1420	17	22
1·2389	2308	2228	2150	2073	1997	1923	1850	1778	1·2026	1945	1865	1787	1710	1634	1560	1487	1415	18	23
1·2382	2301	2221	2143	2066	1990	1916	1843	1771	1·2020	1939	1859	1781	1704	1628	1554	1481	1409	19	24
1·2376	2295	2215	2137	2060	1984	1910	1837	1765	1·2014	1933	1853	1775	1698	1622	1548	1475	1403	20	25
1·2370	2289	2209	2131	2054	1978	1904	1831	1759	1·2008	1927	1847	1769	1692	1616	1542	1467	1397	21	27
1·2363	2282	2202	2124	2047	1971	1897	1824	1752	1·2002	1921	1841	1763	1686	1610	1536	1463	1391	22	28
1·2357	2276	2196	2118	2041	1965	1891	1818	1746	1·1997	1916	1836	1758	1681	1605	1531	1458	1386	23	29
1·2351	2270	2190	2112	2035	1959	1885	1812	1740	1·1991	1910	1830	1752	1675	1599	1525	1452	1380	24	30
1·2345	2264	2184	2106	2029	1953	1879	1806	1734	1·1985	1904	1824	1746	1669	1593	1519	1446	1374	25	32
1·2338	2257	2177	2099	2022	1946	1872	1799	1727	1·1979	1898	1818	1740	1663	1587	1513	1440	1368	26	33
1·2332	2251	2171	2093	2016	1940	1866	1793	1721	1·1974	1893	1813	1735	1658	1582	1508	1435	1363	27	34
1·2326	2245	2165	2087	2010	1934	1860	1787	1715	1·1968	1887	1807	1729	1652	1576	1502	1429	1357	28	35
1·2320	2239	2159	2081	2004	1928	1854	1781	1709	1·1962	1881	1801	1723	1646	1570	1496	1423	1351	29	37
1·2314	2233	2153	2075	1998	1922	1848	1775	1703	1·1957	1876	1796	1718	1641	1565	1491	1418	1346	30	38
1·2307	2226	2146	2068	1991	1915	1841	1768	1696	1·1951	1870	1790	1712	1635	1559	1485	1412	1340	31	39
·2301	2220	2140	2062	1985	1909	1835	1762	1690	1·1945	1864	1784	1706	1629	1553	1479	1406	1334	32	41
·2295	2214	2134	2056	1979	1903	1829	1756	1684	1·1940	1859	1779	1701	1624	1548	1474	1401	1329	33	42
·2289	2208	2128	2050	1973	1897	1823	1750	1678	1·1934	1853	1773	1695	1618	1542	1468	1395	1323	34	43
·2283	2202	2122	2044	1967	1891	1817	1744	1672	1·1928	1847	1767	1689	1612	1536	1462	1389	1317	35	44
·2276	2195	2115	2039	1960	1884	1810	1737	1665	1·1923	1842	1762	1684	1607	1531	1457	1384	1312	36	45
·2270	2189	2109	2031	1954	1878	1804	1731	1659	1·1917	1836	1756	1678	1601	1525	1451	1378	1306	37	47
·2264	2183	2103	2025	1948	1872	1798	1725	1653	1·1911	1830	1750	1672	1595	1519	1445	1372	1300	38	48
·2258	2177	2097	2019	1942	1866	1792	1719	1647	1·1906	1825	1745	1667	1590	1514	1440	1367	1295	39	49
·2252	2171	2091	2013	1936	1860	1786	1713	1641	1·1900	1819	1739	1661	1584	1508	1434	1361	1289	40	51
·2246	2165	2085	2007	1930	1853	1779	1706	1634	1·1894	1813	1733	1655	1578	1502	1428	1355	1283	41	52
·2240	2159	2079	2001	1924	1848	1774	1701	1629	1·1889	1808	1728	1650	1573	1497	1423	1350	1278	42	53
·2233	2152	2072	1994	1917	1841	1767	1694	1622	1·1883	1802	1722	1644	1567	1491	1417	1344	1272	43	54
·2227	2146	2066	1988	1911	1835	1761	1688	1616	1·1878	1797	1717	1639	1562	1486	1412	1339	1267	44	56
·2221	2140	2060	1982	1905	1829	1755	1682	1610	1·1872	1791	1711	1633	1556	1480	1406	1333	1261	45	57
·2215	2134	2054	1976	1899	1823	1749	1676	1604	1·1866	1785	1705	1627	1550	1474	1400	1327	1255	46	58
·2209	2128	2048	1970	1893	1817	1743	1670	1598	1·1861	1780	1700	1622	1545	1469	1395	1322	1250	47	59
·2203	2122	2042	1964	1887	1811	1737	1664	1592	1·1855	1774	1694	1616	1539	1463	1389	1316	1244	48	61
·2197	2116	2036	1958	1881	1805	1731	1658	1586	1·1850	1769	1689	1611	1534	1453	1384	1311	1239	49	62
·2191	2110	2030	1952	1875	1799	1725	1652	1580	1·1844	1763	1683	1605	1528	1452	1378	1305	1233	50	63
·2185	2104	2024	1946	1869	1793	1719	1646	1574	1·1839	1758	1678	1600	1523	1447	1373	1300	1228	51	64
·2179	2098	2018	1940	1863	1787	1713	1640	1568	1·1833	1752	1672	1594	1517	1441	1367	1294	1222	52	66
·2173	2092	2012	1934	1857	1781	1707	1634	1562	1·1828	1747	1667	1589	1512	1436	1362	1289	1217	53	67
·2167	2086	2006	1928	1851	1775	1701	1628	1556	1·1822	1741	1661	1583	1506	1430	1356	1283	1211	54	68
·2161	2080	2000	1922	1845	1769	1695	1622	1550	1·1817	1736	1656	1578	1501	1425	1351	1278	1206	55	69
·2155	2074	1994	1916	1839	1763	1689	1616	1544	1·1811	1730	1650	1572	1495	1419	1345	1272	1200	56	71
·2149	2068	1988	1910	1833	1757	1683	1610	1538	1·1806	1725	1645	1567	1490	1414	1340	1267	1195	57	72
·2143	2062	1982	1904	1827	1751	1677	1604	1532	1·1800	1719	1639	1561	1484	1408	1334	1261	1190	58	73
·2137	2056	1976	1898	1821	1745	1671	1598	1526	1·1795	1714	1634	1556	1479	1403	1329	1256	1184	59	74
53′	54′	55′	56′	57′	58′	59′	60′	61′	53′	54′	55′	56′	57′	58′	59′	60′	61′		

TABLE 34

Logarithms of the Apparent Altitudes and Horizontal Parallax.

	Apparent Altitude 13°									Apparent Altitude 14°									
	Moon's Horizontal Parallax.									Moon's Horizontal Parallax.									
′	53′	54′	55′	56′	57′	58′	59′	60′	61′	53′	54′	55′	56′	57′	58′	59′	60′	61′	′ or ″
0	1·1789	1708	1628	1550	1473	1397	1323	1250	1181	1·1473	1392	1312	1234	1157	1081	1007	0934	0862	0
1	1·1784	1703	1623	1545	1468	1392	1318	1245	1173	1·1468	1387	1307	1229	1152	1076	1002	0929	0857	1
2	1·1778	1697	1617	1539	1462	1386	1312	1239	1167	1·1463	1382	1302	1224	1147	1071	0997	0924	0852	2
3	1·1773	1692	1612	1534	1457	1381	1307	1234	1162	1·1458	1377	1297	1219	1142	1066	0992	0919	0847	3
4	1·1767	1686	1606	1528	1451	1375	1301	1228	1156	1·1453	1372	1292	1214	1137	1061	0987	0914	0842	4
5	1·1762	1681	1601	1523	1446	1370	1296	1223	1151	1·1448	1367	1287	1209	1132	1056	0982	0909	0837	5
6	1·1756	1675	1595	1517	1440	1364	1290	1217	1146	1·1443	1362	1282	1204	1127	1051	0977	0904	0832	6
7	1·1751	1670	1590	1512	1435	1359	1285	1212	1140	1·1438	1357	1277	1199	1122	1046	0972	0899	0827	7
8	1·1746	1665	1585	1507	1430	1354	1280	1207	1135	1·1433	1352	1272	1194	1117	1041	0967	0894	0822	8
9	1·1740	1659	1579	1501	1424	1348	1274	1201	1129	1·1428	1347	1267	1189	1112	1036	0962	0889	0817	9
10	1·1735	1654	1574	1496	1419	1343	1269	1196	1124	1·1423	1342	1262	1184	1107	1031	0957	0884	0812	10
11	1·1729	1648	1568	1490	1413	1337	1263	1190	1118	1·1418	1337	1257	1179	1102	1026	0952	0879	0807	11
12	1·1724	1643	1563	1485	1408	1332	1258	1185	1113	1·1413	1332	1252	1174	1097	1021	0947	0874	0802	12
13	1·1719	1638	1558	1480	1404	1327	1253	1180	1108	1·1408	1327	1247	1169	1092	1016	0942	0869	0797	13
14	1·1713	1632	1552	1474	1397	1321	1247	1174	1102	1·1403	1322	1242	1164	1087	1011	0937	0864	0792	14
15	1·1708	1627	1547	1469	1392	1316	1242	1169	1097	1·1398	1317	1237	1159	1082	1006	0932	0859	0787	15
16	1·1702	1621	1541	1463	1386	1310	1236	1163	1091	1·1393	1312	1232	1154	1077	1001	0927	0854	0782	16
17	1·1697	1616	1536	1458	1381	1305	1231	1158	1086	1·1388	1307	1227	1149	1072	0996	0922	0849	0777	17
18	1·1692	1611	1531	1453	1376	1300	1226	1153	1081	1·1383	1302	1222	1144	1067	0991	0917	0844	0772	18
19	1·1686	1605	1525	1447	1370	1294	1220	1147	1075	1·1378	1297	1217	1139	1062	0986	0912	0839	0767	19
20	1·1681	1600	1520	1442	1365	1289	1215	1142	1070	1·1373	1292	1212	1134	1057	0981	0907	0834	0762	20
21	1·1676	1595	1515	1437	1360	1284	1210	1137	1065	1·1368	1287	1207	1129	1052	0976	0902	0829	0757	21
22	1·1670	1589	1509	1431	1354	1278	1204	1131	1059	1·1363	1282	1202	1124	1047	0971	0897	0824	0752	22
23	1·1665	1584	1504	1425	1348	1272	1198	1125	1054	1·1358	1277	1197	1119	1042	0966	0892	0819	0747	23
24	1·1660	1579	1499	1421	1344	1268	1194	1121	1049	1·1353	1272	1192	1114	1037	0961	0887	0814	0742	24
25	1·1655	1574	1494	1416	1339	1263	1189	1116	1044	1·1348	1267	1187	1109	1032	0956	0882	0809	0737	25
26	1·1649	1568	1488	1410	1333	1257	1183	1110	1038	1·1344	1263	1183	1105	1028	0952	0878	0805	0733	26
27	1·1644	1563	1483	1405	1328	1252	1178	1105	1033	1·1339	1258	1178	1100	1023	0947	0873	0800	0728	27
28	1·1639	1558	1478	1400	1323	1247	1173	1100	1028	1 1334	1253	1173	1095	1018	0942	0868	0795	0723	28
29	1·1633	1552	1472	1394	1317	1241	1167	1094	1022	1·1329	1248	1168	1090	1013	0937	0863	0790	0718	29
30	1·1628	1547	1467	1389	1312	1236	1162	1089	1017	1·1324	1243	1163	1085	1008	0932	0858	0785	0713	30
31	1·1623	1542	1462	1384	1307	1231	1157	1084	1012	1·1319	1238	1158	1080	1003	0927	0853	0780	0708	31
32	1·1618	1537	1457	1379	1302	1226	1152	1079	1007	1·1314	1233	1153	1075	0998	0922	0848	0775	0703	32
33	1·1612	1531	1451	1373	1296	1220	1146	1073	1001	1·1309	1228	1149	1070	0993	0917	0843	0770	0698	33
34	1·1607	1526	1446	1368	1291	1215	1141	1068	0996	1·1305	1224	1144	1066	0989	0913	0839	0766	0694	34
35	1·1602	1521	1441	1363	1286	1210	1136	1063	0991	1·1300	1219	1139	1061	0984	0908	0834	0761	0689	35
36	1·1597	1516	1436	1358	1281	1205	1131	1058	0986	1·1295	1214	1134	1056	0979	0903	0829	0756	0684	36
37	1·1591	1510	1430	1352	1275	1199	1125	1052	0980	1·1290	1209	1129	1051	0974	0898	0824	0751	0679	37
38	1·1586	1505	1425	1347	1270	1194	1120	1047	0975	1·1285	1204	1124	1046	0969	0893	0819	0746	0674	38
39	1·1581	1500	1420	1342	1265	1189	1115	1042	0970	1·1280	1199	1119	1041	0964	0888	0814	0741	0669	39
40	1·1576	1495	1415	1337	1260	1184	1110	1037	0965	1·1275	1194	1114	1036	0959	0883	0809	0736	0664	40
41	1·1571	1490	1410	1332	1255	1179	1105	1032	0960	1·1271	1190	1110	1032	0955	0879	0805	0732	0660	41
42	1·1565	1484	1404	1326	1249	1173	1099	1026	0954	1·1266	1185	1105	1027	0950	0874	0800	0727	0655	42
43	1·1560	1479	1399	1321	1244	1168	1094	1021	0949	1·1261	1180	1100	1022	0945	0869	0795	0722	0650	43
44	1·1555	1474	1394	1316	1239	1163	1089	1016	0944	1·1256	1175	1095	1017	0940	0864	0790	0717	0645	44
45	1·1550	1469	1389	1311	1234	1158	1085	1011	0939	1·1251	1170	1090	1012	0935	0859	9785	0712	0640	45
46	1·1545	1464	1384	1306	1229	1153	1079	1006	0934	1·1247	1166	1086	1008	0931	0855	0781	0708	0636	46
47	1·1540	1459	1379	1301	1224	1148	1074	1001	0929	1·1242	1161	1081	1003	0926	0850	0776	0703	0631	47
48	1·1535	1454	1374	1296	1219	1143	1069	0996	0924	1·1237	1156	1076	0998	0921	0845	0771	0698	0626	48
49	1·1529	1448	1368	1290	1213	1137	1063	0990	0918	1·1232	1151	1071	0993	0916	0840	0766	0693	0621	49
50	1·1524	1443	1363	1285	1208	1132	1058	0985	0913	1·1227	1146	1066	0988	0911	0835	0761	0688	0616	50
51	1·1519	1438	1358	1280	1203	1127	1053	0980	0908	1·1223	1142	1062	0984	0907	0831	0757	0684	0612	51
52	1·1514	1433	1353	1275	1198	1122	1048	0975	0903	1·1218	1137	1057	0979	0902	0826	0752	0679	0607	52
53	1·1509	1428	1348	1270	1193	1117	1043	0970	0898	1·1213	1132	1052	0974	0897	0821	0747	0674	0602	53
54	1·1504	1423	1343	1265	1188	1112	1038	0965	0893	1·1208	1127	1047	0969	0892	0816	0742	0669	0597	55
55	1·1499	1418	1338	1260	1183	1107	1033	0960	0888	1·1204	1123	1043	0965	0888	0812	0738	0665	0593	54
56	1·1494	1413	1333	1255	1178	1102	1028	0955	0883	1·1199	1118	1038	0960	0883	0807	0733	0660	0588	56
57	1·1488	1407	1327	1249	1172	1096	1022	0949	0877	1·1194	1113	1033	0955	0878	0802	0728	0655	0583	57
58	1·1483	1402	1322	1244	1167	1091	1017	0944	0872	1·1189	1108	1028	0950	0873	0797	0723	0650	0578	58
59	1·1478	1397	1317	1239	1162	1086	1012	0939	0867	1·1185	1104	1024	0946	0869	0793	0719	0646	0574	59
	53	54′	55′	56′	57′	58′	59′	60′	61′	53′	54′	55′	56′	57′	58′	59′	60′	61′	

TABLE 34

Logarithms of the Apparent Altitudes and Horizontal Parallax.

Apparent Altitude 15° Moon's Horizontal Parallax.									Apparent Altitude 16° Moon's Horizontal Parallax.									′ or ″	P.P. to ″ of Par.
53′	54′	55′	56′	57′	58′	59′	60′	61′	53′	54′	55′	56′	57′	58′	59′	60′	61′		
1·1180	1099	1019	0941	0864	0788	0714	0641	0569	1·0907	0826	0746	0668	0591	0515	0441	0368	0296	0	—0
1·1175	1094	1014	0936	0859	0783	0709	0636	0564	1·0902	0821	0741	0663	0586	0510	0436	0363	0291	1	1
1·1171	1090	1010	0932	0855	0779	0705	0632	0560	1·0898	0817	0737	0659	0582	0506	0432	0359	0287	2	3
1·1166	1085	1005	0927	0850	0774	0700	0627	0555	1·0893	0812	0732	0654	0577	0501	0427	0354	0282	3	4
1·1161	1080	1000	0922	0845	0769	0695	0622	0550	1·0889	0808	0728	0650	0573	0497	0423	0350	0278	4	5
1·1157	1076	0996	0918	0841	0765	0691	0618	0546	1·0885	0804	0724	0646	0569	0493	0419	0346	0274	5	6
1·1152	1071	0991	0913	0835	0759	0685	0612	0540	1·0880	0799	0719	0641	0564	0488	0414	0341	0269	6	8
1·1147	1066	0986	0908	0831	0755	0681	0608	0536	1·0876	0795	0715	0637	0560	0484	0410	0337	0265	7	9
1·1143	1062	0982	0904	0827	0751	0677	0604	0532	1·0872	0791	0711	0633	0556	0480	0406	0333	0261	8	10
1·1138	1057	0977	0899	0822	0746	0672	0599	0527	1·0867	0786	0706	0628	0551	0475	0401	0328	0256	9	11
1·1133	1052	0972	0894	0817	0741	0667	0594	0522	1·0863	0782	0702	0624	0547	0471	0397	0324	0252	10	13
1·1128	1047	0967	0889	0812	0736	0662	0589	0517	1·0858	0777	0697	0619	0542	0466	0392	0319	0247	11	14
1·1124	1043	0963	0885	0808	0732	0658	0585	0513	1·0854	0773	0693	0615	0538	0462	0388	0315	0243	12	15
1·1119	1038	0958	0880	0803	0727	0653	0580	0508	1·0850	0769	0689	0611	0534	0458	0384	0311	0239	13	17
1·1115	1034	0954	0876	0799	0723	0649	0576	0504	1·0845	0764	0684	0606	0529	0453	0379	0306	0234	14	18
1·1110	1029	0949	0871	0794	0718	0644	0571	0499	1·0841	0760	0680	0602	0525	0449	0375	0302	0230	15	19
1·1105	1024	0944	0866	0789	0713	0639	0566	0494	1·0837	0756	0676	0598	0521	0445	0371	0298	0226	16	20
1·1101	1020	0940	0862	0785	0709	0635	0562	0490	1·0832	0751	0671	0593	0516	0440	0366	0293	0221	17	22
1·1096	1015	0935	0857	0780	0704	0630	0557	0485	1·0828	0747	0667	0589	0512	0436	0362	0289	0217	18	23
1·1091	1010	0930	0852	0775	0699	0625	0552	0480	1·0824	0743	0663	0585	0508	0432	0358	0285	0213	19	24
1·1087	1006	0926	0848	0771	0695	0621	0548	0476	1·0819	0738	0658	0580	0503	0427	0353	0280	0208	20	25
1·1082	1001	0921	0843	0766	0690	0616	0543	0471	1·0815	0734	0654	0576	0499	0423	0349	0276	0204	21	27
1·1078	0997	0917	0839	0762	0686	0612	0539	0467	1·0811	0730	0650	0572	0495	0419	0345	0272	0200	22	28
1·1073	0992	0912	0834	0757	0681	0607	0534	0462	1·0807	0726	0646	0568	0491	0415	0341	0268	0196	23	29
1·1068	0987	0907	0829	0752	0676	0602	0529	0457	1·0802	0721	0641	0563	0486	0410	0336	0263	0191	24	30
1·1064	0983	0903	0825	0748	0672	0598	0525	0453	1·0798	0717	0637	0559	0482	0406	0332	0259	0187	25	32
1·1059	0978	0898	0820	0743	0667	0593	0520	0448	1·0794	0713	0633	0555	0478	0402	0328	0255	0183	26	33
1·1055	0974	0894	0816	0739	0663	0589	0516	0444	1·0789	0708	0628	0550	0473	0397	0323	0250	0178	27	34
1·1050	0969	0889	0811	0734	0658	0584	0511	0439	1 0785	0704	0624	0546	0469	0393	0319	0246	0174	28	35
1·1046	0965	0885	0807	0730	0654	0580	0507	0435	1·0781	0700	0620	0542	0465	0389	0315	0242	0170	29	37
1·1041	0960	0880	0802	0725	0649	0575	0502	0430	1·0777	0696	0616	0538	0461	0385	0311	0238	0166	30	38
1·1036	0955	0875	0797	0720	0644	0570	0497	0425	1·0772	0691	0611	0533	0456	0380	0306	0233	0161	31	39
1·1032	0951	0871	0793	0716	0640	0566	0493	0421	1·0768	0687	0607	0529	0452	0376	0302	0229	0157	32	41
1·1027	0946	0866	0788	0711	0635	0561	0488	0416	1·0764	0683	0603	0525	0448	0372	0298	0225	0153	33	42
1·1023	0942	0862	0784	0707	0631	0557	0484	0412	1·0760	0679	0599	0521	0444	0368	0294	0221	0149	34	43
1·1018	0937	0857	0779	0702	0626	0542	0479	0407	1·0755	0674	0594	0516	0439	0363	0289	0216	0144	35	44
1·1014	0933	0853	0775	0698	0622	0548	0475	0403	1·0751	0670	0590	0512	0435	0359	0285	0212	0140	36	45
1·1009	0928	0848	0770	0693	0617	0543	0470	0398	1·0747	0666	0586	0508	0431	0355	0281	0208	0136	37	47
1·1005	0924	0844	0766	0689	0613	0539	0466	0394	1·0743	0662	0582	0504	0427	0351	0277	0204	0132	38	48
1·1000	0919	0839	0761	0684	0608	0534	0461	0389	1·0738	0657	0577	0499	0422	0346	0272	0199	0127	39	49
1·0996	0915	0835	0757	0680	0604	0530	0457	0385	1·0734	0653	0573	0495	0418	0342	0268	0195	0123	40	51
1·0991	0911	0831	0753	0675	0599	0525	0452	0380	1·0730	0649	0569	0491	0414	0338	0264	0191	0119	41	52
1·0987	0906	0826	0748	0671	0595	0521	0448	0376	1·0726	0645	0565	0487	0410	0334	0260	0187	0115	42	53
1·0982	0901	0821	0743	0665	0589	0515	0442	0370	1·0722	0641	0561	0483	0406	0330	0256	0183	0111	43	54
1·0978	0897	0817	0739	0662	0586	0512	0439	0367	1·0717	0636	0556	0478	0401	0325	0251	0178	0106	44	56
1·0973	0892	0812	0734	0657	0581	0507	0434	0362	1·0713	0632	0552	0474	0397	0321	0247	0174	0102	45	57
1·0969	0888	0808	0730	0653	0577	0503	0430	0358	1·0709	0628	0548	0470	0393	0317	0243	0170	0098	46	58
1·0964	0883	0803	0725	0648	0572	0498	0425	0353	1·0705	0624	0544	0466	0389	0313	0239	0166	0094	47	59
1·0960	0879	0799	0721	0644	0568	0494	0421	0349	1·0701	0620	0540	0462	0385	0309	0235	0162	0090	48	61
1·0955	0874	0794	0716	0639	0563	0489	0416	0344	1·0696	0615	0535	0457	0380	0304	0230	0157	0085	49	62
1·0951	0870	0790	0712	0635	0559	0485	0412	0340	1·0692	0611	0531	0453	0376	0300	0226	0153	0081	50	63
1·0946	0865	0785	0707	0630	0554	0480	0407	0335	1·0688	0607	0527	0449	0372	0296	0222	0149	0077	51	64
1·0942	0861	0781	0703	0625	0549	0475	0402	0330	1·0684	0603	0523	0445	0368	0292	0218	0145	0073	52	66
1·0938	0857	0777	0699	0622	0546	0472	0399	0327	1·0680	0599	0519	0441	0364	0288	0214	0141	0069	53	67
1·0933	0852	0772	0694	0617	0541	0467	0394	0322	1·0676	0595	0515	0437	0360	0284	0210	0137	0065	54	68
1·0929	0848	0768	0690	0613	0537	0463	0390	0318	1·0671	0590	0510	0432	0355	0279	0205	0132	0060	55	69
1·0924	0843	0763	0685	0608	0532	0458	0385	0313	1·0667	0586	0506	0428	0351	0275	0201	0128	0056	56	71
1·0920	0839	0759	0681	0604	0528	0454	0381	0309	1·0663	0582	0502	0424	0347	0271	0197	0124	0052	57	72
1·0915	0834	0754	0676	0599	0523	0449	0376	0304	1·0659	0578	0498	0420	0343	0267	0193	0120	0048	58	73
1·0911	0830	0750	0672	0595	0519	0445	0372	0300	1·0655	0574	0494	0416	0339	0263	0189	0116	0044	59	74
53′	54	55′	56′	57′	58′	59′	60′	61′	53′	54′	55′	56′	57′	58′	59′	60′	61′		

TABLE 34

Logarithms of the Apparent Altitudes and Horizontal Parallax.

	Apparent Altitude 17°									Apparent Altitude 18°									
	Moon's Horizontal Parallax.									Moon's Horizontal Parallax.									
′	53′	54′	55′	56′	57′	58′	59′	60′	61′	53′	54′	55′	56′	57′	58′	59′	60′	61′	′ or ″
0	1 ·0651	0570	0490	0412	0335	0259	0185	0112	0040	1 ·0410	0329	0249	0171	0094	0018	9944	9871	9799	0
1	1 ·0647	0566	0486	0408	0331	0255	0181	0108	0036	1 ·0406	0325	0245	0167	0090	0014	9940	9867	9795	1
2	1 ·0642	0561	0481	0403	0326	0250	0176	0103	0031	1 ·0402	0321	0241	0163	0086	0010	9936	9863	9791	2
3	1 ·0638	0557	0477	0399	0322	0246	0172	0099	0027	1 ·0399	0318	0238	0160	0083	0007	9933	9860	9788	3
4	1 ·0634	0553	0473	0395	0318	0242	0168	0095	0023	1 ·0395	0314	0234	0156	0079	·003	9929	9856	9784	4
5	1 ·0630	0549	0469	0391	0314	0237	0163	0090	0018	1 ·0391	0310	0230	0152	0075	9999	9925	9852	9780	5
6	1 ·0626	0545	0465	0387	0310	0234	0160	0087	0015	1 ·0387	0306	0226	0148	0071	9995	9921	9848	9776	6
7	1 ·0622	0541	0461	0383	0306	0230	0156	0083	0011	1 ·0383	0302	0222	0144	0067	9991	9917	9844	9772	7
8	1 ·0618	0537	0457	0379	0302	0226	0152	0079	0007	1 ·0379	0298	0218	0140	0063	9987	9913	9840	9768	8
9	1 ·0614	0533	0453	0375	0298	0222	0148	0075	·003	1 ·0375	0294	0214	0136	0059	9983	9909	9836	9764	9
10	1 ·0610	0529	0449	0371	0294	0218	0144	0071	9999	1 ·0371	0290	0210	0132	0055	9979	9905	9832	9760	10
11	1 ·0605	0524	0444	0366	0289	0213	0139	0066	9994	1 ·0368	0287	0207	0129	0052	9976	9902	9829	9757	11
12	1 ·0601	0520	0440	0362	0285	0209	0135	0062	9990	1 ·0364	0283	0203	0125	0048	9972	9898	9825	9753	12
13	1 ·0597	0516	0436	0358	0281	0205	0131	0058	9986	1 ·0360	0279	0199	0121	0044	9968	9894	9821	9749	13
14	1 ·0593	0512	0432	0354	0277	0201	0127	0054	9982	1 ·0356	0275	0195	0117	0040	9964	9890	9817	9745	14
15	1 ·0589	0508	0428	0350	0273	0197	0123	0049	9977	1 ·0352	0271	0191	0113	0036	9960	9886	9813	9741	15
16	1 ·0585	0504	0424	0346	0269	0193	0119	0046	9973	1 ·0348	0267	0187	0109	0032	9956	9882	9809	9737	16
17	1 ·0581	0500	0420	0342	0265	0189	0115	0041	9969	1 ·0345	0264	0184	0106	0029	9953	9879	9806	9734	17
18	1 ·0577	0496	0416	0338	0261	0185	0111	0038	9966	1 ·0341	0260	0180	0102	0025	9949	9875	9802	9730	18
19	1 ·0573	0492	0412	0334	0257	0181	0107	0034	9962	1 ·0337	0256	0176	0098	0021	9945	9871	9798	9726	19
20	1 ·0569	0488	0408	0330	0253	0177	0103	0030	9958	1 ·0333	0252	0172	0094	0017	9941	9867	9794	9722	20
21	1 ·0565	0484	0404	0326	0249	0173	0099	0026	9954	1 ·0329	0248	0168	0090	0013	9937	9863	9790	9718	21
22	1 ·0561	0480	0400	0322	0245	0169	0095	0022	9950	1 ·0326	0245	0165	0087	0010	9934	9860	9787	9715	22
23	1 ·0557	0476	0396	0318	0241	0165	0091	0018	9946	1 ·0322	0241	0161	0083	0006	9930	9856	9783	9711	23
24	1 ·0553	0472	0392	0314	0237	0161	0087	0014	9942	1 ·0318	0237	0157	0079	·002	9926	9852	9779	9707	24
25	1 ·0549	0468	0388	0310	0233	0157	0083	0010	9938	1 ·0314	0233	0153	0075	9998	9922	9848	9775	9703	25
26	1 ·0545	0464	0384	0306	0229	0153	0079	0006	9934	1 ·0310	0229	0149	0071	9994	9918	9844	9771	9699	26
27	1 ·0541	0460	0380	0302	0225	0149	0075	·002	9930	1 ·0307	0226	0146	0068	9991	9915	9841	9768	9696	27
28	1 ·0537	0456	0376	0298	0221	0145	0071	9998	9926	1 ·0303	0222	0142	0064	9987	9911	9837	9764	9692	28
29	1 ·0533	0452	0372	0294	0217	0141	0067	9994	9922	1 ·0299	0218	0138	0060	9983	9907	9833	9760	9688	29
30	1 ·0529	0448	0368	0290	0213	0137	0063	9990	9918	1 ·0295	0214	0134	0056	9979	9903	9829	9756	9684	30
31	1 ·0525	0444	0364	0286	0209	0133	0059	9986	9914	1 ·0291	0210	0130	0052	9975	9899	9825	9752	9680	31
32	1 ·0521	0440	0360	0282	0205	0129	0055	9982	9910	1 ·0288	0207	0127	0049	9972	9896	9822	9749	9677	32
33	1 ·0517	0436	0356	0278	0201	0125	0051	9978	9906	1 0284	0203	0123	0045	9968	9892	9818	9745	9673	33
34	1 ·0513	0432	0352	0274	0197	0121	0047	9974	9902	1 ·0280	0199	0119	0041	9964	9888	9814	9741	9669	34
35	1 ·0509	0428	0348	0270	0193	0117	0043	9970	9898	1 ·0276	0195	0115	0037	9960	9884	9810	9737	9665	35
36	1 ·0505	0424	0344	0266	0189	0113	0039	9966	9894	1 ·0273	0192	0112	0034	9957	9881	9807	9734	9662	36
37	1 ·0501	0420	0340	0262	0185	0109	0035	9962	9890	1 ·0269	0188	0108	0030	9953	9877	9803	9730	9658	37
38	1 ·0497	0416	0336	0258	0181	0105	0031	9958	9886	1 ·0265	0184	0104	0026	9949	9873	9799	9726	9654	38
39	1 ·0493	0412	0332	0254	0177	0101	0027	9954	9882	1 ·0261	0180	0100	0022	9945	9869	9795	9722	9650	39
40	1 ·0489	0408	0328	0250	0173	0097	0023	9950	9878	1 ·0258	0177	0097	0019	9942	9866	9792	9719	9647	40
41	1 ·0485	0404	0324	0246	0169	0093	0019	9946	9874	1 ·0254	0173	0093	0015	9938	9862	9788	9715	9643	41
42	1 ·0481	0400	0320	0242	0165	0089	0015	9942	9870	1 ·0250	0169	0089	0011	9934	9858	9784	9711	9639	42
43	1 ·0477	0396	0316	0238	0161	0085	0011	9938	9866	1 ·0246	0165	0085	0007	9930	9854	9780	9707	9635	43
44	1 ·0473	0392	0312	0234	0157	0081	0007	9934	9862	1 ·0243	0162	0082	0004	9927	9851	9777	9704	9632	44
45	1 ·0469	0388	0308	0230	0153	0077	·003	9930	9858	1 ·0239	0158	0078	·000	9923	9847	9773	9700	9628	45
46	1 ·0465	0384	0304	0226	0149	0073	9999	9926	9854	1 ·0235	0154	0074	9996	9919	9843	9769	9696	9624	46
47	1 ·0461	0380	0300	0222	0145	0069	9995	9922	9850	1 ·0232	6151	0071	9993	9916	9840	9766	9693	9621	47
48	1 ·0457	0376	0296	0218	0141	0065	9991	9918	9846	1 ·0228	0147	0067	9989	9912	9836	9762	9689	9617	48
49	1 ·0453	0372	0292	0214	0137	0061	9987	9914	9842	1 ·0224	0143	0063	9985	9908	9832	9758	9685	9613	49
50	1 ·0449	0368	0288	0210	0133	0057	9983	9910	9838	1 ·0220	0139	0059	9981	9904	9828	9754	9681	9609	50
51	1 ·0445	0364	0284	0206	0129	0053	9979	9906	9834	1 ·0217	0136	0056	9978	9901	9825	9751	9678	9606	51
52	1 ·0441	0360	0280	0202	0125	0049	9975	9902	9830	1 ·0213	0132	0052	9974	9897	9821	9747	9674	9602	52
53	1 ·0437	0356	0276	0198	0121	0045	9971	9898	9826	1 ·0209	0128	0048	9970	9893	9817	9743	9670	9598	53
54	1 ·0434	0353	0273	0195	0118	0042	9968	9895	9823	1 ·0206	0125	0045	9967	9890	9814	9740	9667	9595	54
55	1 ·0430	0349	0269	0191	0114	0038	9064	9891	9819	1 ·0202	0121	0041	9963	9886	9810	9736	9663	9591	55
56	1 ·0426	0345	0265	0187	0110	0034	9960	9887	9815	1 ·0198	0117	0037	9959	9882	9806	9732	9659	9587	56
57	1 ·0422	0341	0261	0183	0106	0030	9956	9883	9811	1 ·0195	0114	0034	9956	8879	9803	9729	9656	9584	57
58	1 ·0418	0337	0257	0179	0102	0026	9952	9879	9807	1 ·0191	0110	0030	9952	9875	9799	9725	9652	9580	58
59	1 ·0414	0333	0253	0175	0098	0022	9948	9875	9803	1 ·0187	0106	0026	9948	9871	9795	9721	9648	9576	59

Logarithms of the Apparent Altitudes and Horizontal Parallax.

Apparent Altitude 19°									Apparent Altitude 20°									′ or ″	P.P. to ″ of Par.
Moon's Horizontal Parallax.									Moon's Horizontal Parallax.										
53′	54′	55′	56′	57′	58′	59′	60′	61′	53′	54′	55′	56′	57′	58′	59′	60′	61′		
1 ·0184	0103	0023	9945	9868	9792	9718	9645	9573	0 ·9969	9888	9808	9730	9653	9577	9503	9430	9358	0	—0
1 ·0180	0099	0019	9941	9864	9788	9714	9641	9569	·9966	9885	9805	9727	9650	9574	9500	9427	9355	1	1
1 ·0176	0095	0015	9937	9860	9784	9710	9637	9565	·9963	9882	9802	9724	9647	9571	9497	9424	9352	2	3
1 ·0173	0092	0012	9934	9856	9780	9706	9633	9561	·9959	9878	9798	9720	9643	9567	9493	9420	9348	3	4
1 ·0169	0088	0008	9930	9853	9777	9703	9630	9558	·9956	9875	9795	9717	9640	9564	9490	9417	9345	4	5
1 ·0165	0084	0004	9926	9849	9773	9699	9626	9554	·9952	9871	9791	9713	9636	9560	9486	9413	9341	5	6
1 ·0162	0081	·001	9923	9846	9770	9696	9623	9551	·9949	9868	9788	9710	9633	9557	9483	9410	9338	6	8
1 ·0158	0077	9997	9919	9842	9766	9692	9619	9547	·9945	9864	9784	9706	9629	9553	9479	9406	9334	7	9
1 ·0154	0073	9993	9915	9838	9762	9688	9615	9543	·9942	9861	9781	9703	9626	9550	9476	9403	9331	8	10
1 ·0151	0070	9990	9912	9835	9759	9685	9612	9540	·9938	9857	9777	9699	9622	9546	9472	9399	9327	9	11
1 ·0147	0066	9986	9908	9831	9755	9681	9608	9536	·9935	9854	9774	9696	9619	9543	9469	9396	9324	10	13
1 ·0143	0062	9982	9904	9827	9751	9677	9604	9532	·9931	9850	9770	9692	9615	9539	9465	9392	9320	11	14
1 ·0140	0059	9979	9901	9824	9748	9674	9601	9528	·9928	9847	9767	9689	9612	9536	9462	9389	9317	12	15
1 ·0136	0055	9975	9897	9820	9744	9670	9597	9525	·9925	9844	9764	9686	9609	9533	9459	9386	9314	13	17
1 ·0133	0052	9972	9894	9817	9741	9667	9594	9522	·9921	9840	9760	9682	9605	9529	9455	9382	9310	14	18
1 ·0129	0048	9968	9890	9813	9737	9663	9590	9518	·9918	9837	9757	9679	9602	9526	9452	9379	9307	15	19
1 ·0125	0044	9964	9886	9809	9733	9659	9586	9514	·9914	9833	9753	9675	9598	9522	9448	9375	9303	16	20
1 ·0122	0041	9961	9883	9806	9730	9656	9583	9511	·9911	9830	9750	9672	9595	9519	9445	9372	9300	17	22
1 ·0118	0037	9957	9879	9802	9726	9652	9579	9507	·9908	9827	9747	9669	9592	9516	9442	9369	9297	18	23
1 ·0114	0033	9953	9875	9798	9722	9648	9575	9503	·9904	9823	9743	9665	9588	9512	9438	9365	9293	19	24
1 ·0111	0030	9950	9872	9795	9719	9645	9572	9500	·9901	9820	9740	9662	9585	9509	9435	9362	9290	20	25
1 ·0107	0026	9946	9868	9791	9715	9641	9568	9496	·9897	9816	9736	9658	9581	9505	9431	9358	9286	21	27
1 ·0104	0023	9943	9865	9788	9712	9638	9565	9493	·9894	9813	9733	9655	9578	9502	9428	9355	9283	22	28
1 ·0100	0019	9939	9861	9784	9708	9634	9561	9489	·9890	9809	9729	9651	9574	9498	9424	9351	9279	23	29
1 ·0097	0016	9936	9858	9781	9705	9631	9558	9486	·9887	9806	9726	9648	9571	9495	9421	9348	9276	24	30
1 ·0093	0012	9932	9854	9777	9701	9627	9554	9482	·9884	9803	9723	9645	9568	9492	9418	9345	9273	25	32
1 ·0089	0008	9928	9850	9773	9697	9623	9550	9478	·9880	9799	9719	9641	9564	9488	9414	9341	9269	26	33
1 ·0086	0005	9925	9847	9770	9694	9620	9547	9475	·9877	9796	9716	9638	9561	9485	9411	9338	9266	27	34
1 ·0082	·001	9921	9843	9766	9690	9616	9543	9471	·9874	9793	9713	9635	9558	9482	9408	9335	9263	28	35
1 ·0079	9998	9918	9840	9763	9687	9613	9540	9468	·9870	9789	9709	9631	9554	9478	9404	9331	9259	29	37
1 ·0075	9994	9914	9836	9759	9683	9609	9536	9464	·9867	9786	9706	9628	9551	9475	9401	9328	9256	30	38
1 ·0071	9990	9910	9832	9755	9679	9605	9532	9460	·9863	9782	9702	9624	9547	9471	9397	9324	9252	31	39
1 ·0068	9987	9907	9829	9752	9676	9602	9529	9457	·9860	9779	9699	9621	9544	9468	9394	9321	9249	32	41
1 ·0064	9983	9903	9825	9748	9672	9598	9525	9453	·9857	9776	9696	9618	9541	9465	9391	9318	9246	33	42
1 ·0061	9980	9899	9821	9744	9668	9594	9521	9449	·9853	9772	9692	9614	9537	9461	9387	9314	9242	34	43
1 ·0057	9976	9896	9818	9741	9665	9591	9518	9446	·9850	9769	9689	9611	9534	9458	9384	9311	9239	35	44
1 ·0054	9973	9893	9815	9738	9662	9588	9515	9443	·9847	9766	9686	9608	9531	9455	9381	9308	9236	36	45
1 ·0050	9969	9889	9811	9734	9658	9584	9511	9439	·9843	9762	9682	9604	9527	9451	9377	9304	9232	37	47
1 ·0047	9966	9886	9808	9731	9655	9581	9508	9436	·9840	9759	9679	9601	9524	9448	9374	9301	9229	38	48
1 ·0043	9962	9882	9804	9727	9651	9577	9504	9432	·9836	9755	9675	9597	9520	9444	9370	9297	9225	39	49
1 ·0040	9959	9879	9801	9724	9648	9574	9501	9429	·9833	9752	9672	9594	9517	9441	9367	9294	9222	40	51
1 ·0036	9955	9875	9797	9720	9644	9570	9497	9425	·9830	9749	9669	9591	9514	9438	9364	9291	9219	41	52
1 ·0032	9951	9871	9793	9716	9640	9566	9493	9421	·9826	9745	9665	9587	9510	9434	9360	9287	9215	42	53
1 ·0029	9948	9868	9790	9713	9637	9563	9490	9418	9823	9742	9662	9584	9507	9431	9357	9284	9212	43	54
1 ·0025	9944	9864	9786	9709	9633	9559	9486	9414	9820	9739	9659	9581	9504	9428	9354	9281	9209	44	56
1 ·0022	9941	9861	9783	9706	9630	9556	9483	9411	9816	9735	9655	9577	9500	9424	9350	9277	9205	45	57
1 ·0018	9937	9857	9779	9702	9626	9552	9479	9407	·9813	9732	9652	9574	9497	9421	9347	9274	9202	46	58
1 ·0015	9934	9854	9776	9699	9623	9549	9476	9404	·9810	9729	9649	9571	9494	9418	9344	9271	9199	47	59
1 ·0011	9930	9850	9772	9695	9619	9545	9472	9400	·9806	9725	9645	9567	9490	9414	9340	9267	9195	48	61
1 ·0008	9927	9847	9769	9692	9616	9542	9469	9397	·9803	9722	9642	9564	9487	9411	9337	9264	9192	49	62
1 ·0004	9923	9843	9765	9688	9612	9538	9465	9393	·9800	9719	9639	9561	9484	9408	9334	9261	9189	50	63
1 ·0001	9920	9840	9762	9685	9609	9535	9462	9390	·9796	9715	9635	9557	9480	9404	9330	9257	9185	51	64
0 ·9997	9916	9836	9758	9681	9605	9531	9458	9386	·9793	9712	9632	9554	9477	9401	9327	9254	9182	52	66
9994	9913	9833	9755	9678	9602	9528	9455	9383	·9790	9709	9629	9551	9474	9398	9323	9251	9178	53	67
9990	9909	9829	9751	9674	9598	9524	0451	9379	·9787	9706	9626	9548	9471	9395	9320	9248	9175	54	68
9987	9906	9826	9748	9671	9595	9521	9448	9376	·9783	9702	9622	9544	9467	9391	9317	9244	9172	55	69
9983	9902	9822	9744	9667	9591	9517	9444	9372	·9780	9699	9619	9541	9464	9388	9314	9241	9169	56	71
9980	9899	9819	9741	9664	9588	9514	9441	9369	·9777	9696	9616	9538	9461	9385	9311	9238	9166	57	72
9976	9895	9815	9737	9660	9584	9510	9437	9365	·9773	9692	9612	9534	9457	9381	9307	9234	9162	58	73
9973	9892	9812	9734	9657	9581	9507	9434	9362	·9770	9689	9609	9531	9454	9378	9304	9231	9159	59	74
53′	54′	55′	56′	57′	58′	59′	60′	61′	53′	54′	55′	56′	57′	58′	59′	60′	61′		

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TABLE 34

Logarithms of the Apparent Altitudes and Horizontal Parallax.

′	Apparent Altitude 21°									Apparent Altitude 22°									″ or ′	P.P. to ″ of Par.
	Moon's Horizontal Parallax.									Moon's Horizontal Parallax.										
	53′	54′	55′	56′	57′	58′	59′	60′	61′	53′	54′	55′	56′	57′	58′	59′	60′	61′		
0	0·9767	9686	9606	9528	9451	9375	9301	9228	9156	0·9574	9493	9413	9335	9258	9182	9108	9035	8963	0	0
1	·9763	9682	9602	9524	9447	9371	9297	9224	9152	·9571	9490	9410	9332	9255	9179	9105	9032	8960	1	1
2	·9760	9679	9599	9521	9444	9368	9294	9221	9149	·9568	9487	9407	9329	9252	9176	9102	9029	8957	2	3
3	·9757	9676	9596	9518	9441	9365	9291	9218	9146	·9565	9484	9404	9326	9249	9173	9099	9026	8954	3	4
4	·9754	9673	9593	9515	9438	9362	9288	9215	9143	·9562	9481	9401	9323	9246	9170	9096	9023	8951	4	5
5	·9750	9669	9589	9511	9434	9358	9284	9211	9139	·9559	9478	9398	9320	9243	9167	9093	9020	8948	5	6
6	·9747	9666	9586	9508	9431	9355	9281	9208	9136	·9556	9475	9395	9317	9240	9164	9090	9017	8945	6	8
7	·9744	9663	9583	9505	9428	9352	9278	9205	9133	·9552	9471	9391	9313	9236	9160	9086	9013	8941	7	9
8	·9740	9659	9579	9501	9424	9348	9274	9201	9129	·9549	9468	9388	9310	9233	9157	9083	9010	8938	8	10
9	·9737	9656	9576	9498	9421	9345	9271	9198	9126	·9546	9465	9385	9307	9230	9154	9080	9007	8935	9	11
10	·9734	9653	9573	9495	9418	9342	9268	9195	9123	·9543	9462	9382	9304	9227	9151	9077	9004	8932	10	13
11	·9731	9650	9570	9492	9415	9339	9265	9192	9120	·9540	9459	9379	9301	9224	9148	9074	9001	8929	11	14
12	·9727	9646	9566	9488	9411	9335	9261	9188	9116	·9537	9456	9376	9298	9221	9145	9071	8998	8926	12	15
13	·9724	9643	9563	9485	9408	9332	9258	9185	9113	·9534	9453	9373	9295	9218	9142	9068	8995	8923	13	17
14	·9721	9640	9560	9482	9405	9329	9255	9182	9110	·9531	9450	9370	9292	9215	9139	9065	8992	8920	14	18
15	·9718	9637	9557	9479	9402	9326	9252	9179	9107	·9528	9447	9367	9289	9212	9136	9062	8989	8917	15	19
16	·9714	9633	9553	9475	9398	9322	9248	9175	9103	·9525	9444	9364	9286	9209	9133	9059	8986	8914	16	20
17	·9711	9630	9550	9472	9395	9319	9245	9172	9100	·9521	9440	9360	9282	9205	9129	9055	8982	8910	17	21
18	·9708	9627	9547	9469	9392	9316	9242	9169	9097	·9518	9437	9357	9279	9202	9126	9052	8979	8907	18	23
19	·9705	9624	9544	9466	9389	9313	9239	9166	9094	·9515	9434	9354	9276	9199	9123	9049	8976	8904	19	24
20	·9701	9620	9540	9462	9385	9309	9235	9162	9090	·9512	9431	9351	9273	9196	9120	9046	8973	8901	20	25
21	·9698	9617	9537	9459	9382	9306	9232	9159	9087	·9509	9428	9348	9270	9193	9117	9043	8970	8898	21	27
22	·9695	9614	9534	9456	9379	9303	9229	9156	9084	·9506	9425	9345	9267	9190	9114	9040	8967	8895	22	28
23	·9692	9611	9531	9453	9376	9300	9226	9153	9081	·9503	9422	9342	9264	9187	9111	9037	8964	8892	23	29
24	·9689	9608	9528	9450	9373	9297	9223	9150	9078	·9500	9419	9339	9261	9184	9108	9034	8961	8889	24	30
25	·9685	9604	9524	9446	9369	9293	9219	9146	9074	·9497	9416	9336	9258	9181	9105	9031	8958	8886	25	32
26	·9682	9601	9521	9443	9366	9290	9216	9143	9071	·9494	9413	9333	9255	9178	9102	9028	8955	8883	26	33
27	·9679	9598	9518	9440	9363	9287	9213	9140	9068	·9491	9410	9330	9252	9175	9099	9025	8952	8880	27	34
28	·9676	9595	9515	9437	9360	9284	9210	9137	9065	·9488	9407	9327	9249	9172	9096	9022	8949	8877	28	35
29	·9672	9591	9511	9433	9356	9280	9206	9133	9061	·9485	9404	9324	9246	9169	9093	9019	8946	8874	29	37
30	·9669	9588	9508	9430	9353	9277	9203	9130	9058	·9482	9401	9321	9243	9166	9090	9016	8943	8871	30	38
31	·9666	9585	9505	9427	9350	9274	9200	9127	9055	·9479	9398	9318	9240	9163	9087	9013	8940	8868	31	39
32	·9663	9582	9502	9424	9347	9271	9197	9124	9052	·9476	9395	9315	9237	9160	9084	9010	8937	8865	32	41
33	·9660	9579	9499	9421	9344	9268	9194	9121	9049	·9472	9391	9311	9233	9156	9080	9006	8933	8861	33	42
34	·9656	9575	9495	9417	9340	9264	9190	9117	9045	·9469	9388	9308	9230	9153	9077	9003	8930	8858	34	43
35	·9653	9572	9492	9414	9337	9261	9187	9114	9042	·9466	9385	9305	9227	9150	9074	9000	8927	8855	35	44
36	·9650	9569	9489	9411	9334	9258	9184	9111	9039	·9463	9382	9302	9224	9147	9071	8997	8924	8852	36	45
37	·9647	9566	9486	9408	9331	9255	9181	9108	9036	·9460	9379	9299	9221	9144	9068	8994	8921	8849	37	47
38	·9644	9563	9483	9405	9328	9252	9178	9105	9033	·9457	9376	9296	9218	9141	9065	8991	8918	8846	38	48
39	·9640	9559	9479	9401	9324	9248	9174	9101	9029	·9454	9373	9293	9215	9138	9062	8988	8915	8843	39	49
40	·9637	9556	9476	9398	9321	9245	9171	9098	9026	·9451	9370	9290	9212	9135	9059	8985	8912	8840	40	51
41	·9634	9553	9473	9395	9318	9242	9168	9095	9023	·9448	9367	9287	9209	9132	9056	8982	8909	8837	41	52
42	·9631	9550	9470	9392	9315	9239	9165	9092	9020	·9445	9364	9284	9206	9129	9053	8979	8906	8834	42	53
43	·9628	9547	9467	9389	9312	9236	9162	9089	9017	·9442	9361	9281	9203	9126	9050	8976	8903	8831	43	54
44	·9625	9544	9464	9386	9309	9233	9159	9086	9014	·9439	9358	9278	9200	9123	9047	8973	8900	8828	44	56
45	·9621	9540	9460	9382	9305	9229	9155	9082	9010	·9436	9355	9275	9197	9120	9044	8970	8897	8825	45	57
46	·9618	9537	9457	9379	9302	9226	9152	9079	9007	·9433	9352	9272	9194	9117	9041	8967	8894	8822	46	58
47	·9615	9534	9454	9376	9299	9223	9149	9076	9004	·9430	9349	9269	9191	9114	9038	8964	8891	8819	47	59
48	·9612	9531	9451	9373	9296	9220	9146	9073	9001	·9427	9346	9266	9188	9111	9035	8961	8888	8816	48	61
49	·9609	9528	9448	9370	9293	9217	9143	9070	8998	·9424	9343	9263	9185	9108	9032	8958	8885	8813	49	62
50	·9606	9525	9445	9367	9290	9214	9140	9067	8995	·9421	9340	9260	9182	9105	9029	8955	8882	8810	50	63
51	·9602	9521	9441	9363	9286	9210	9136	9063	8991	·9418	9337	9257	9179	9102	9026	8952	8879	8807	51	64
52	·9599	9518	9438	9360	9283	9207	9133	9060	8988	·9415	9334	9254	9176	9099	9023	8949	8876	8804	52	66
53	·9596	9515	9435	9357	9280	9204	9130	9057	8985	·9412	9331	9251	9173	9096	9020	8946	8873	8801	53	67
54	·9593	9512	9432	9354	9277	9201	9127	9054	8982	·9409	9328	9248	9170	9093	9017	8943	8870	8798	54	68
55	·9590	9509	9429	9351	9274	9198	9124	9051	8979	·9406	9325	9245	9167	9090	9014	8940	8867	8795	55	69
56	·9587	9506	9426	9348	9271	9195	9121	9048	8976	·9403	9322	9242	9164	9087	9011	8937	8864	8792	56	71
57	·9584	9503	9423	9345	9268	9192	9118	9045	8973	·9400	9319	9239	9161	9084	9008	8934	8861	8789	57	72
58	·9580	9499	9419	9341	9264	9188	9114	9041	8969	·9397	9316	9236	9158	9081	9005	8931	8858	8786	58	73
59	·9577	9496	9416	9338	9261	9185	9111	9038	8966	·9394	9313	9233	9155	9078	9002	8928	8855	8783	59	74

TABLE 34

Logarithms of the Apparent Altitudes and Horizontal Parallax.

Apparent Altitude 23°									Apparent Altitude 24°									′ or ″	P.P. to ″ of Par.
Moon's Horizontal Parallax.									Moon's Horizontal Parallax.										
53′	54′	55′	56′	57′	58′	59′	60′	61′	53′	54′	55′	56′	57′	58′	59′	60′	61′		
0 ·9391	9310	9230	9152	9075	8999	8925	8852	8780	0 ·9217	9136	9056	8978	8901	8825	8751	8678	8606	0	—0
·9388	9307	9227	9149	9072	8996	8922	8849	8777	·9214	9133	9053	8975	8898	8822	8748	8675	8603	1	1
·9385	9304	9224	9146	9069	8993	8919	8846	8774	·9211	9130	9050	8972	8895	8819	8745	8672	8600	2	3
·9382	9301	9221	9143	9066	8990	8916	8843	8771	·9208	9127	9047	8969	8892	8816	8742	8669	8597	3	4
·9379	9298	9218	9140	9063	8987	8913	8840	8768	·9206	9125	9045	8967	8890	8814	8740	8667	8595	4	5
·9376	9295	9215	9137	9060	8984	8910	8837	8765	·9203	9122	9042	8964	8887	8811	8737	8664	8592	5	6
·9373	9292	9212	9134	9057	8981	8907	8834	8762	·9200	9119	9039	8961	8884	8808	8734	8661	8589	6	8
·9370	9289	9209	9131	9054	8978	8904	8831	8759	·9197	9116	9036	8958	8881	8805	8731	8658	8586	7	9
·9367	9286	9206	9128	9051	8975	8901	8828	8756	·9194	9113	9033	8955	8878	8802	8728	8655	8583	8	10
·9365	9284	9204	9126	9049	8973	8899	8826	8754	·9191	9110	9030	8952	8875	8799	8725	8652	8580	9	11
·9362	9281	9201	9123	9046	8970	8896	8823	8751	·9189	9108	9028	8950	8873	8797	8723	8650	8578	10	13
·9359	9278	9198	9120	9043	8967	8893	8820	8748	·9186	9105	9025	8947	8870	8794	8720	8647	8575	11	14
·9356	9275	9195	9117	9040	8964	8890	8817	8745	·9183	9102	9022	8944	8867	8791	8717	8644	8572	12	15
·9353	9272	9192	9114	9037	8961	8887	8814	8742	·9180	9099	9019	8941	8864	8788	8714	8641	8569	13	17
·9350	9269	9189	9111	9034	8958	8884	8811	8739	·9177	9096	9016	8938	8861	8785	8711	8638	8566	14	18
·9347	9266	9186	9108	9031	8955	8881	8808	8736	·9175	9094	9014	8936	8859	8783	8709	8636	8564	15	19
·9344	9263	9183	9105	9028	8952	8878	8805	8733	·9172	9091	9011	8933	8856	8780	8706	8633	8561	16	20
·9341	9260	9180	9102	9025	8949	8875	8802	8730	·9169	9088	9008	8930	8853	8777	8703	8630	8558	17	22
·9338	9257	9177	9099	9022	8946	8872	8799	8727	·9166	9085	9005	8927	8850	8774	8700	8627	8555	18	23
·9335	9254	9174	9096	9019	8943	8869	8796	8724	·9163	9082	9002	8924	8847	8771	8697	8624	8552	19	24
·9332	9251	9171	9093	9016	8940	8866	8793	8721	·9161	9080	9000	8922	8845	8769	8695	8622	8550	20	25
·9329	9248	9168	9090	9013	8937	8863	8790	8718	·9158	9077	8997	8919	8842	8766	8692	8619	8547	21	27
·9326	9245	9165	9087	9010	8934	8860	8787	8715	·9155	9074	8994	8916	8839	8763	8689	8616	8544	22	28
·9323	9242	9162	9084	9007	8931	8857	8784	8712	·9152	9071	8991	8913	8836	8760	8686	8613	8541	23	29
·9320	9239	9159	9081	9004	8928	8854	8781	8709	·9149	9068	8988	8910	8833	8757	8683	8610	8538	24	30
·9318	9237	9157	9079	9002	8926	8852	8779	8707	·9147	9066	8986	8908	8831	8755	8681	8608	8536	25	32
·9315	9234	9154	9076	8999	8923	8849	8776	8704	·9144	9063	8983	8905	8828	8752	8678	8605	8533	26	33
·9312	9231	9151	9073	8996	8920	8846	8773	8701	·9141	9060	8980	8902	8825	8749	8675	8602	8530	27	34
·9309	9228	9148	9070	8993	8917	8843	8770	8698	·9138	9057	8977	8899	8822	8746	8672	8599	8527	28	35
·9306	9225	9145	9067	8990	8914	8840	8767	8695	·9135	9054	8974	8896	8819	8743	8669	8596	8524	29	37
·9303	9222	9142	9064	8987	8911	8837	8764	8692	·9133	9052	8972	8894	8817	8741	8667	8594	8522	30	38
·9300	9219	9139	9061	8984	8908	8834	8761	8689	·9130	9049	8969	8891	8814	8738	8664	8591	8519	31	39
·9297	9216	9136	9058	8981	8905	8831	8758	8686	·9127	9046	8966	8888	8811	8735	8661	8588	8516	32	41
·9294	9213	9133	9055	8978	8902	8828	8755	8683	·9124	9043	8963	8885	8808	8732	8658	8585	8513	33	42
·9291	9210	9130	9052	8975	8899	8825	8752	8680	·9122	9041	8961	8883	8806	8730	8656	8583	8511	34	43
·9288	9207	9127	9049	8972	8896	8822	8749	8677	·9119	9038	8958	8880	8803	8727	8653	8580	8508	35	44
·9286	9205	9125	9047	8970	8894	8820	8747	8675	·9116	9035	8955	8877	8800	8724	8650	8577	8505	36	45
·9283	9202	9122	9044	8967	8891	8817	8744	8672	·9113	9032	8952	8874	8797	8721	8647	8574	8502	37	47
·9280	9199	9119	9041	8964	8888	8814	8741	8669	·9111	9030	8950	8872	8795	8719	8645	8572	8500	38	48
·9277	9196	9116	9038	8961	8885	8811	8738	8666	·9108	9027	8947	8869	8792	8716	8642	8569	8497	39	49
·9274	9193	9113	9035	8958	8882	8808	8735	8663	·9105	9024	8944	8866	8789	8713	8639	8566	8494	40	51
·9271	9190	9110	9032	8955	8879	8805	8732	8660	·9102	9021	8941	8863	8786	8710	8636	8563	8491	41	52
·9268	9187	9107	9029	8952	8876	8802	8729	8657	·9099	9019	8939	8861	8784	8708	8634	8561	8489	42	53
·9265	9184	9104	9026	8949	8873	8799	8726	8654	·9097	9016	8936	8858	8781	8705	8631	8558	8486	43	54
·9263	9182	9102	9024	8947	8871	8797	8724	8652	·9094	9013	8933	8855	8778	8702	8628	8555	8483	44	56
·9260	9179	9099	9021	8944	8868	8794	8721	8649	·9091	9010	8930	8852	8775	8699	8625	8552	8480	45	57
·9257	9176	9096	9018	8941	8865	8791	8718	8646	·9089	9008	8928	8850	8773	8697	8623	8550	8478	46	58
·9254	9173	9093	9015	8938	8862	8788	8715	8643	·9086	9005	8925	8847	8770	8694	8620	8547	8475	47	59
·9251	9170	9090	9012	8935	8859	8785	8712	8640	·9083	9002	8922	8844	8767	8691	8617	8544	8472	48	61
·9248	9167	9087	9009	8932	8856	8782	8709	8637	·9080	8999	8919	8841	8764	8688	8614	8541	8469	49	62
·9245	9164	9084	9006	8929	8853	8779	8706	8634	·9078	8997	8917	8839	8762	8686	8612	8539	8467	50	63
·9242	9161	9081	9003	8926	8850	8776	8703	8631	·9075	8994	8914	8836	8759	8683	8609	8536	8464	51	64
·9240	9159	9079	9001	8924	8848	8774	8701	8629	·9072	8991	8911	8833	8756	8680	8606	8533	8461	52	66
·9237	9156	9076	8998	8921	8845	8771	8698	8626	·9070	8989	8909	8831	8754	8678	8604	8531	8459	53	67
·9234	9153	9073	8995	8918	8842	8768	8695	8623	·9067	8986	8906	8828	8751	8675	8601	8528	8456	54	68
·9231	9150	9070	8992	8915	8839	8765	8692	8620	·9064	8983	8903	8825	8748	8672	8598	8525	8453	55	69
·9228	9147	9067	8989	8912	8836	8762	8689	8617	·9061	8980	8900	8822	8745	8669	8595	8522	8450	56	71
·9225	9144	9064	8986	8909	8833	8759	8686	8614	·9059	8978	8898	8820	8743	8667	8593	8520	8448	57	72
·9223	9142	9062	8984	8907	8831	8757	8684	8612	·9056	8975	8895	8817	8740	8664	8590	8517	8445	58	73
·9220	9139	9059	8981	8904	8828	8754	8681	8609	·9053	8972	8892	8814	8737	8661	8587	8514	8442	59	74
53′	54′	55′	56′	57′	58′	59′	60′	61′	53′	54′	55′	56′	57′	58′	59′	60′	61′		

TABLE 34

Logarithms of the Apparent Altitudes and Horizontal Parallax.

	Apparent Altitude 25°									Apparent Altitude 26°									
	Moon's Horizontal Parallax.									Moon's Horizontal Parallax.									′ or ″
′	53′	54′	55′	56′	57′	58′	59′	60′	61′	53′	54′	55′	56′	57′	58′	59′	60′	61′	
0	0 ·9051	8970	8890	8812	8735	8659	8585	8512	8440	0 ·8892	8811	8731	8653	8576	8500	8426	8353	8281	0
1	·9048	8967	8887	8809	8732	8656	8582	8509	8437	·8889	8808	8728	8650	8573	8497	8423	8350	8278	1
2	·9045	8964	8884	8806	8729	8653	8579	8506	8434	·8886	8805	8725	8647	8570	8494	8420	8347	8275	2
3	·9042	8961	8881	8803	8726	8650	8576	8503	8431	·8884	8803	8723	8645	8568	8492	8418	8345	8273	3
4	·9040	8959	8879	8801	8724	8648	8574	8501	8429	·8881	8800	8720	8642	8565	8489	8415	8342	8270	4
5	·9037	8956	8876	8798	8721	8645	8571	8498	8426	·8879	8798	8718	8640	8563	8487	8413	8340	8268	5
6	·9034	8953	8873	8795	8718	8642	8568	8495	8423	·8876	8795	8715	8637	8560	8484	8410	8337	8265	6
7	·9032	8951	8871	8793	8716	8640	8566	8493	8421	·8873	8792	8712	8634	8557	8481	8407	8334	8262	7
8	·9029	8948	8868	8790	8713	8637	8563	8490	8418	·8871	8790	8710	8632	8555	8479	8405	8332	8260	8
9	·9026	8945	8865	8787	8710	8634	8560	8487	8415	·8868	8787	8707	8629	8552	8476	8402	8329	8257	9
10	·9024	8943	8863	8785	8708	8632	8558	8485	8413	·8866	8785	8705	8627	8550	8474	8400	8327	8255	10
11	·9021	8940	8860	8782	8705	8629	8555	8482	8410	·8863	8782	8702	8624	8547	8471	8397	8324	8252	11
12	·9018	8937	8857	8779	8702	8626	8552	8479	8407	·8861	8780	8700	8622	8545	8469	8395	8322	8250	12
13	·9015	8934	8854	8776	8699	8623	8549	8476	8404	·8858	8777	8697	8619	8542	8466	8392	8319	8247	13
14	·9013	8932	8852	8774	8697	8621	8547	8474	8402	·8855	8774	8694	8616	8539	8463	8389	8316	8244	14
15	·9010	8929	8849	8771	8694	8618	8544	8471	8399	·8853	8772	8692	8614	8537	8461	8387	8314	8242	15
16	·9007	8926	8846	8768	8691	8615	8541	8468	8396	·8850	8769	8689	8611	8534	8458	8384	8311	8239	16
17	·9005	8924	8844	8766	8689	8613	8539	8466	8394	·8848	8767	8687	8609	8532	8456	8382	8309	8237	17
18	·9002	8921	8841	8763	8686	8610	8536	8463	8391	·8845	8764	8684	8606	8529	8453	8379	8306	8234	18
19	·8999	8918	8838	8760	8683	8607	8533	8460	8388	·8843	8762	8682	8604	8527	8451	8377	8304	8232	19
20	·8997	8916	8836	8758	8681	8605	8531	8458	8386	·8840	8759	8679	8601	8524	8448	8374	8301	8229	20
21	·8994	8913	8833	8755	8678	8602	8528	8455	8383	·8838	8757	8677	8599	8522	8446	8372	8299	8227	21
22	·8991	8910	8830	8752	8675	8599	8525	8452	8380	·8835	8754	8674	8596	8519	8443	8369	8296	8225	22
23	·8989	8908	8828	8750	8673	8597	8523	8450	8378	·8833	8752	8672	8594	8517	8441	8367	8294	8222	23
24	·8986	8905	8825	8747	8670	8594	8520	8447	8375	·8830	8749	8669	8591	8514	8438	8364	8291	8219	24
25	·8983	8902	8822	8744	8667	8591	8517	8444	8372	·8827	8746	8666	8588	8511	8435	8361	8288	8216	25
26	·8981	8900	8820	8742	8665	8589	8515	8442	8370	·8825	8744	8664	8586	8509	8433	8359	8286	8214	26
27	·8978	8897	8817	8739	8662	8586	8512	8439	8367	·8822	8741	8661	8583	8506	8430	8356	8283	8211	27
28	·8975	8894	8814	8736	8659	8583	8509	8436	8364	·8820	8739	8659	8581	8504	8428	8354	8281	8209	28
29	·8973	8892	8812	8734	8657	8581	8507	8434	8362	·8817	8736	8656	8578	8501	8425	8351	8278	8206	29
30	·8970	8889	8809	8731	8654	8578	8504	8431	8359	·8815	8734	8654	8576	8499	8423	8349	8276	8204	30
31	·8968	8887	8807	8729	8652	8576	8502	8429	8357	·8812	8731	8651	8573	8496	8420	8346	8273	8201	31
32	·8965	8884	8804	8726	8649	8573	8499	8426	8354	·8810	8729	8649	8571	8494	8418	8344	8271	8199	32
33	·8962	8881	8801	8723	8646	8570	8496	8423	8351	·8807	8726	8646	8568	8491	8415	8341	8268	8196	33
34	·8960	8879	8799	8721	8644	8568	8494	8421	8349	·8805	8724	8644	8566	8489	8413	8339	8266	8194	34
35	·8957	8876	8796	8718	8641	8565	8491	8418	8346	·8802	8721	8641	8563	8486	8410	8336	8263	8191	35
36	·8954	8873	8793	8715	8638	8562	8488	8415	8343	·8800	8719	8639	8561	8484	8408	8334	8261	8189	36
37	·8952	8871	8791	8713	8636	8560	8486	8413	8341	·8797	8716	8636	8558	8481	8405	8331	8258	8186	37
38	·8949	8868	8788	8710	8633	8557	8483	8410	8338	·8795	8714	8634	8556	8479	8403	8329	8256	8184	38
39	·8946	8865	8785	8707	8630	8554	8480	8407	8335	·8792	8711	8631	8553	8476	8400	8326	8253	8181	39
40	·8944	8863	8783	8705	8628	8552	8478	8405	8333	·8790	8709	8629	8551	8474	8398	8324	8251	8179	40
41	·8941	8860	8780	8702	8625	8549	8475	8402	8330	·8787	8706	8626	8548	8471	8395	8321	8248	8176	41
42	·8939	8858	8778	8700	8623	8447	8473	8400	8328	·8784	8703	8623	8545	8468	8392	8318	8245	8173	42
43	·8936	8855	8775	8697	8620	8544	8470	8397	8325	·8782	8701	8621	8543	8466	8390	8316	8243	8171	43
44	·8933	8852	8772	8694	8617	8541	8467	8394	8322	·8779	8698	8618	8540	8463	8387	8313	8240	8168	44
45	·8931	8850	8770	8692	8615	8539	8465	8392	8320	·8777	8696	8616	8538	8461	8385	8311	8238	8166	45
46	·8928	8847	8767	8689	8612	8536	8462	8389	8317	·8774	8693	8613	8535	8458	8382	8308	8235	8163	46
47	·8925	8844	8764	8686	8609	8533	8459	8386	8314	·8772	8691	8611	8533	8456	8380	8306	8233	8161	47
48	·8923	8842	8762	8684	8607	8531	8457	8384	8312	·8769	8688	8608	8530	8453	8377	8303	8230	8158	48
49	·8920	8839	8759	8681	8604	8528	8454	8381	8309	·8767	8686	8606	8528	8451	8375	8301	8228	8156	49
50	·8918	8837	8757	8679	8602	8526	8452	8379	8307	·8764	8683	8603	8525	8448	8372	8298	8225	8153	50
51	·8915	8834	8754	8676	8599	8523	8449	8376	8304	·8762	8681	8601	8523	8446	8370	8296	8223	8151	51
52	·8912	8831	8751	8673	8596	8520	8446	8373	8301	·8759	8678	8598	8520	8443	8367	8293	8220	8148	52
53	·8910	8829	8749	8671	8594	8518	8444	8371	8299	·8757	8676	8596	8518	8441	8365	8291	8218	8146	53
54	·8907	8826	8746	8668	8591	8515	8441	8368	8296	·8754	8673	8593	8515	8438	8362	8288	8215	8143	54
55	·8905	8824	8744	8666	8589	8513	8139	8366	8294	·8752	8671	8591	8513	8436	8360	8286	8213	8141	55
56	·8902	8821	8741	8663	8586	8510	8436	8363	8291	·8749	8669	8589	8511	8434	8358	8284	8211	8139	56
57	·8899	8818	8738	8660	8583	8507	8433	8360	8288	·8747	8666	8586	8508	8431	8355	8281	8208	8136	57
58	·8897	8816	8736	8658	8581	8505	8431	8358	8286	·8744	8663	8583	8505	8428	8352	8278	8205	8133	58
59	·8894	8813	8733	8655	8578	8502	8428	8355	8283	·8742	8661	8581	8503	8426	8350	8276	8203	8131	59
	53′	54′	55′	56′	57′	58′	59′	60′	61′	53′	54′	55′	56′	57′	58′	59′	60′	61′	

TABLE 34

Logarithms of the Apparent Altitudes and Horizontal Parallax.

Apparent Altitude 27°									Apparent Altitude 28°									′ or ″	P.P. to ″ of Par.
Moon's Horizontal Parallax.									Moon's Horizontal Parallax.										
53′	54′	55′	56′	57′	58′	59′	60′	61′	53′	54′	55′	56′	57′	58′	59′	60′	61′		
0 ·8740	8659	8579	8501	8424	8348	8274	8201	8129	0 ·8594	8513	8433	8355	8278	8202	8128	8055	7983	0	—0
·8737	8656	8576	8498	8421	8345	8271	8198	8126	·8592	8511	8431	8353	8276	8200	8126	8053	7981	1	1
·8735	8654	8574	8496	8419	8343	8269	8196	8124	·8589	8508	8428	8350	8273	8197	8123	8050	7978	2	3
·8732	8651	8571	8493	8416	8340	8266	8193	8121	·8587	8506	8426	8348	8271	8195	8121	8048	7976	3	4
·8730	8649	8568	8491	8414	8338	8264	8191	8119	·8584	8503	8423	8345	8268	8192	8118	8045	7973	4	5
·8727	8646	8566	8488	8411	8335	8261	8188	8116	·8582	8501	8421	8343	8266	8190	8116	8043	7971	5	6
·8725	8644	8564	8486	8409	8333	8259	8186	8114	·8580	8499	8419	8341	8264	8188	8114	8041	7969	6	8
·8722	8641	8561	8483	8406	8330	8256	8183	8111	·8577	8496	8416	8338	8261	8185	8111	8038	7966	7	9
·8720	8639	8559	8481	8404	8328	8254	8181	8109	·8575	8494	8414	8336	8259	8183	8109	8036	7964	8	10
·8717	8636	8556	8478	8401	8325	8251	8178	8106	·8573	8492	8412	8334	8257	8181	8107	8034	7962	9	11
·8715	8634	8554	8476	8399	8323	8249	8176	8104	·8570	8489	8409	8331	8254	8178	8104	8031	7959	10	13
·8712	8631	8551	8473	8396	8320	8246	8173	8101	·8568	8487	8407	8329	8252	8176	8102	8029	7957	11	14
·8710	8629	8549	8471	8394	8318	8244	8171	8099	·8566	8485	8405	8327	8250	8174	8100	8027	7955	12	15
·8707	8626	8546	8468	8391	8315	8241	8168	8096	·8563	8482	8402	8324	8247	8171	8097	8024	7952	13	17
·8705	8624	8544	8466	8389	8313	8239	8166	8094	·8561	8480	8400	8322	8245	8169	8095	8022	7950	14	18
·8703	8622	8542	8463	8386	8310	8236	8163	8091	·8558	8477	8397	8319	8242	8166	8092	8019	7947	15	19
·8700	8619	8539	8461	8384	8308	8234	8161	8089	·8556	8475	8395	8317	8240	8164	8090	8017	7945	16	20
·8698	8617	8537	8459	8382	8306	8232	8159	8087	·8554	8473	8393	8315	8238	8162	8088	8015	7943	17	22
·8695	8614	8534	8456	8379	8303	8229	8156	8084	·8551	8470	8390	8312	8235	8159	8085	8012	7940	18	23
·8693	8612	8532	8454	8377	8301	8227	8154	8082	·8549	8468	8388	8310	8233	8157	8083	8010	7938	19	24
·8690	8609	8529	8451	8374	8298	8224	8151	8079	·8547	8466	8386	8308	8231	8155	8081	8008	7936	20	25
·8688	8607	8527	8449	8372	8296	8222	8149	8077	·8544	8463	8383	8305	8228	8152	8078	8005	7933	21	27
·8685	8604	8524	8446	8369	8293	8219	8146	8074	·8542	8461	8381	8303	8226	8150	8076	8003	7931	22	28
·8683	8602	8522	8444	8367	8291	8217	8144	8072	·8540	8459	8379	8301	8224	8148	8074	8001	7929	23	29
·8681	8600	8520	8442	8365	8289	8215	8142	8070	·8537	8456	8376	8298	8221	8145	8071	7998	7926	24	30
·8678	8597	8517	8439	8362	8286	8212	8139	8067	·8535	8454	8374	8296	8219	8143	8069	7996	7924	25	32
·8676	8595	8515	8437	8360	8284	8210	8137	8065	·8533	8452	8372	8294	8217	8141	8067	7994	7922	26	33
·8673	8592	8512	8434	8357	8281	8207	8134	8062	·8530	8449	8369	8291	8214	8138	8064	7991	7919	27	34
·8671	8590	8510	8432	8355	8279	8205	8132	8060	·8528	8447	8367	8289	8212	8136	8062	7989	7917	28	35
·8668	8587	8507	8429	8352	8276	8202	8129	8057	·8526	8445	8365	8287	8210	8134	8060	7987	7914	29	37
·8666	8585	8505	8427	8350	8274	8200	8127	8055	·8523	8442	8362	8284	8207	8131	8057	7984	7912	30	38
·8664	8583	8503	8425	8348	8272	8198	8125	8053	·8521	8440	8360	8282	8205	8129	8055	7982	7910	31	39
·8661	8580	8500	8422	8345	8269	8195	8122	8050	·8519	8438	8358	8280	8203	8127	8053	7980	7908	32	41
·8659	8578	8498	8420	8343	8267	8193	8120	8048	·8516	8435	8355	8277	8200	8124	8050	7977	7905	33	42
·8656	8575	8495	8417	8340	8264	8190	8117	8045	·8514	8433	8353	8275	8198	8122	8048	7975	7903	34	43
·8654	8573	8493	8415	8338	8262	8188	8115	8043	·8512	8431	8351	8273	8196	8120	8046	7973	7901	35	44
·8651	8570	8490	8412	8335	8259	8185	8112	8040	·8509	8428	8348	8270	8193	8117	8043	7970	7898	36	45
·8649	8568	8488	8410	8333	8257	8183	8110	8038	·8507	8426	8346	8268	8191	8115	8041	7968	7896	37	47
·8647	8566	8486	8408	8331	8255	8181	8108	8036	·8505	8424	8344	8266	8189	8113	8039	7966	7894	38	48
·8644	8563	8483	8405	8328	8252	8178	8105	8033	·8502	8421	8341	8263	8186	8110	8036	7963	7891	39	49
·8642	8561	8481	8403	8326	8250	8176	8103	8031	·8500	8419	8339	8261	8184	8108	8034	7961	7889	40	51
·8639	8558	8478	8400	8323	8247	8173	8100	8028	·8498	8417	8337	8259	8182	8106	8032	7959	7887	41	52
·8637	8556	8476	8398	8321	8245	8171	8098	8026	·8496	8415	8335	8257	8180	8104	8030	7957	7885	42	53
·8635	8554	8474	8396	8319	8243	8169	8096	8024	·8493	8412	8332	8254	8177	8101	8027	7954	7882	43	54
·8632	8551	8471	8393	8316	8240	8166	8093	8021	·8491	8410	8330	8252	8175	8099	8025	7952	7880	44	56
·8630	8549	8469	8391	8314	8238	8164	8091	8019	·8489	8408	8328	8250	8173	8097	8023	7950	7878	45	57
·8627	8546	8467	8388	8311	8235	8161	8088	8016	·8486	8405	8325	8247	8170	8094	8020	7947	7875	46	58
·8625	8544	8464	8386	8309	8233	8159	8086	8014	·8484	8403	8323	8245	8168	8092	8018	7945	7873	47	59
·8623	8542	8462	8384	8307	8231	8157	8084	8012	·8482	8401	8321	8243	8166	8090	8016	7943	7871	48	61
·8620	8539	8459	8381	8304	8228	8154	8081	8009	·8479	8398	8318	8240	8163	8087	8013	7940	7868	49	62
·8618	8537	8457	8379	8302	8226	8152	8079	8007	·8477	8396	8316	8238	8161	8085	8011	7938	7866	50	63
·8615	8534	8454	8376	8299	8223	8149	8076	8004	·8475	8394	8314	8236	8159	8083	8009	7936	7864	51	64
·8613	8532	8452	8374	8297	8221	8147	8074	8002	·8473	8392	8312	8234	8157	8081	8007	7934	7862	52	66
·8611	8530	8450	8372	8295	8219	8145	8072	8000	·8470	8389	8309	8231	8154	8078	8004	7931	7859	53	67
·8608	8527	8447	8369	8292	8216	8142	8069	7997	·8468	8387	8307	8229	8152	8076	8002	7929	7857	54	68
·8606	8525	8445	8367	8290	8214	8140	8067	7995	·8466	8385	8305	8227	8150	8074	8000	7927	7855	55	69
·8603	8522	8442	8364	8287	8211	8137	8064	7992	·8463	8382	8302	8224	8147	8071	7997	7924	7852	56	71
·8601	8520	8440	8362	8285	8209	8135	8062	7990	·8461	8380	8300	8222	8145	8069	7995	7922	7850	57	72
·8599	8518	8438	8360	8283	8207	8133	8060	7988	·8459	8378	8298	8220	8143	8067	7993	7920	7848	58	73
·8596	8515	8435	8357	8280	8204	8130	8057	7985	·8457	8376	8296	8218	8141	8065	7991	7918	7846	59	74

TABLE 31

Logarithms of the Apparent Altitudes and Horizontal Parallax.

′	Apparent Altitude 29°									Apparent Altitude 30°									′ or ″	P.P. to ″ of Par
	Moon's Horizontal Parallax.									Moon's Horizontal Parallax.										
′	53′	54′	55′	56′	57′	58′	59′	60′	61′	53′	54′	55′	56′	57′	58′	59′	60′	61′	″	
0	0 ·8454	8373	8293	8215	8138	8062	7988	7915	7843	0 ·8320	8239	8159	8081	8004	7928	7854	7781	7709	0	0
1	·8452	8371	8291	8213	8136	8060	7986	7913	7841	·8318	8237	8157	8079	8002	7926	7852	7779	7707	1	1
2	·8450	8369	8289	8211	8134	8058	7984	7911	7839	·8316	8235	8155	8077	8000	7924	7850	7777	7705	2	3
3	·8447	8366	8286	8208	8131	8055	7981	7908	7836	·8314	8233	8153	8075	7998	7922	7848	7775	7703	3	4
4	·8445	8364	8284	8206	8129	8053	7979	7906	7834	·8312	8231	8151	8073	7996	7920	7846	7773	7701	4	5
5	·8443	8362	8282	8204	8127	8051	7977	7904	7832	·8309	8229	8149	8071	7994	7918	7844	7771	7699	5	6
6	·8441	8360	8280	8202	8125	8049	7975	7902	7830	·8307	8226	8146	8068	7991	7915	7841	7768	7696	6	8
7	·8438	8357	8277	8199	8122	8046	7972	7899	7827	·8305	8224	8144	8066	7989	7913	7839	7766	7694	7	9
8	·8436	8355	8275	8197	8120	8044	7970	7897	7825	·8303	8222	8142	8064	7987	7911	7837	7764	7692	8	10
9	·8434	8353	8273	8195	8118	8042	7968	7895	7823	·8301	8220	8140	8062	7985	7909	7835	7762	7690	9	11
10	·8432	8351	8271	8193	8116	8040	7966	7893	7821	·8298	8218	8138	8060	7983	7907	7833	7760	7688	10	13
11	·8429	8349	8269	8191	8114	8038	7964	7891	7819	·8296	8215	8135	8057	7980	7904	7830	7757	7685	11	14
12	·8427	8346	8266	8188	8111	8035	7961	7888	7816	·8294	8213	8133	8055	7978	7902	7828	7755	7683	12	15
13	·8425	8344	8264	8186	8109	8033	7959	7886	7814	·8292	8211	8131	8053	7976	7900	7826	7753	7681	13	17
14	·8423	8342	8262	8184	8107	8031	7957	7884	7812	·8290	8209	8129	8051	7974	7898	7824	7751	7679	14	18
15	·8420	8339	8259	8181	8104	8028	7954	7881	7809	·8288	8207	8127	8049	7972	7896	7822	7749	7677	15	19
16	·8418	8337	8257	8179	8102	8026	7952	7879	7807	·8285	8204	8124	8046	7969	7893	7819	7746	7674	16	20
17	·8416	8335	8255	8177	8100	8024	7950	7877	7805	·8283	8202	8122	8044	7967	7891	7817	7744	7672	17	22
18	·8414	8333	8253	8175	8098	8022	7948	7875	7803	·8281	8200	8120	8042	7965	7889	7815	7742	7670	18	23
19	·8411	8330	8250	8172	8095	8019	7945	7872	7800	·8279	8198	8118	8040	7963	7887	7813	7740	7668	19	24
20	·8409	8328	8248	8170	8093	8017	7943	7870	7798	·8277	8196	8116	8038	7961	7885	7811	7738	7666	20	25
21	·8407	8326	8246	8168	8091	8015	7941	7868	7796	·8275	8194	8114	8036	7959	7883	7809	7736	7664	21	27
22	·8405	8324	8244	8166	8089	8013	7939	7866	7794	·8273	8192	8112	9034	7957	7881	7807	7734	7662	22	28
23	·8402	8321	8241	8163	8086	8010	7936	7863	7791	·8270	8189	8109	8031	7954	7878	7804	7731	7659	23	29
24	·8400	8319	8239	8161	8084	8008	7934	7861	7789	·8268	8187	8107	8029	7952	7876	7802	7729	7657	24	30
25	·8398	8317	8237	8159	8082	8006	7932	7859	7787	·8266	8185	8105	8027	7950	7874	7800	7727	7655	25	32
26	·8396	8315	8235	8157	8080	8004	7930	7857	7785	·8264	8183	8103	8025	7948	7872	7798	7725	7653	26	33
27	·8393	8312	8232	8154	8077	8001	7927	7854	7782	·8262	8181	8101	8023	7946	7870	7796	7723	7651	27	34
28	·8391	8310	8230	8152	8075	7999	7925	7852	7780	·8260	8179	8099	8021	7944	7868	7794	7721	7649	28	35
29	·8389	8308	8228	8150	8073	7997	7923	7850	7778	·8257	8176	8096	8018	7941	7865	7791	7718	7646	29	37
30	·8387	8306	8226	8148	8071	7995	7921	7848	7776	·8255	8174	8094	8016	7939	7863	7789	7716	7644	30	38
31	·8384	8303	8223	8145	8068	7992	7918	7845	7773	·8253	8172	8092	8014	7937	7861	7787	7714	7642	31	39
32	·8382	8301	8221	8143	8066	7990	7916	7843	7771	·8251	8170	8090	8012	7935	7859	7785	7712	7640	32	41
33	·8380	8299	8219	8141	8064	7988	7914	7841	7769	·8249	8168	8088	8010	7933	7857	7783	7710	7638	33	42
34	·8378	8297	8217	8139	8062	7986	7912	7839	7767	·8247	8166	8086	8008	7931	7855	7781	7708	7636	34	43
35	·8375	8294	8214	8136	8059	7983	7909	7836	7764	·8245	8164	8084	8006	7929	7853	7779	7706	7634	35	44
36	·8373	8292	8212	8134	8057	7981	7907	7834	7762	·8242	8161	8081	8003	7926	7850	7776	7703	7631	36	45
37	·8371	8290	8210	8132	8055	7979	7905	7832	7760	·8240	8159	8079	8001	7924	7848	7774	7701	7629	37	47
38	·8369	8288	8208	8130	8053	7977	7903	7830	7758	·8238	8157	8077	7999	7922	7846	7772	7699	7627	38	48
39	·8367	8286	8206	8128	8051	7975	7901	7828	7756	·8236	8155	8075	7997	7920	7844	7770	7697	7625	39	49
40	·8364	8283	8203	8125	8048	7972	7898	7825	7753	·8234	8153	8073	7995	7918	7842	7768	7695	7623	40	51
41	·8362	8281	8201	8123	8046	7970	7896	7823	7751	·8232	8151	8071	7993	7916	7840	7766	7693	7621	41	52
42	·8360	8279	8199	8121	8044	7968	7894	7821	7749	·8230	8149	8069	7991	7914	7838	7764	7691	7619	42	53
43	·8358	8277	8197	8119	8042	7966	7892	7819	7747	·8228	8147	8067	7989	7912	7836	7762	7689	7617	43	54
44	·8355	8274	8194	8116	8039	7963	7889	7816	7744	·8225	8144	8064	7986	7909	7833	7759	7686	7614	44	56
45	·8353	8272	8192	8114	8037	7961	7887	7814	7742	·8223	8142	8062	7984	7907	7831	7757	7684	7612	45	57
46	·8351	8270	8190	8112	8035	7959	7885	7812	7740	·8221	8140	8060	7982	7905	7829	7755	7682	7610	46	58
47	·8349	8268	8188	8110	8033	7957	7883	7810	7738	·8219	8138	8058	7980	7903	7827	7753	7680	7608	47	59
48	·8347	8266	8186	8108	8031	7955	7881	7808	7736	·8217	8136	8056	7978	7901	7825	7751	7678	7606	48	61
49	·8344	8263	8183	8105	8028	7952	7878	7805	7733	·8215	8134	8054	7976	7899	7823	7749	7676	7604	49	62
50	·8342	8261	8181	8103	8026	7950	7876	7803	7731	·8213	8132	8052	7974	7897	7821	7747	7674	7602	50	63
51	·8340	8259	8179	8101	8024	7948	7874	7801	7729	·8211	8130	8050	7972	7895	7819	7745	7672	7600	51	64
52	·8338	8257	8177	8099	8022	7946	7872	7799	7727	·8208	8127	8047	7969	7892	7816	7742	7669	7597	52	66
53	·8336	8255	8175	8097	8020	7944	7870	7797	7725	·8206	8125	8045	7967	7890	7814	7740	7667	7595	53	67
54	·8333	8252	8172	8094	8017	7941	7867	7794	7722	·8204	8123	8043	7965	7888	7812	7738	7665	7593	54	68
55	·8331	8250	8170	8092	8015	7939	7865	7792	7720	·8202	8121	8041	7963	7886	7810	7736	7663	7591	55	69
56	·8329	8248	8168	8090	8013	7937	7863	7790	7718	·8200	8119	8039	7961	7884	7808	7734	7661	7589	56	71
57	·8327	8246	8166	8088	8011	7935	7861	7788	7716	·8198	8117	8037	7959	7882	7806	7732	7659	7587	57	72
58	·8325	8244	8164	8086	8009	7933	7859	7786	7714	·8196	8115	8035	7957	7880	7804	7730	7657	7585	58	73
59	·8322	8241	8161	8083	8006	7930	7856	7783	7711	·8194	8113	8033	7955	7878	7802	7728	7655	7583	59	74
	53′	54′	55′	56′	57′	58′	59′	60′	61′	53′	54′	55′	56′	57′	58′	59′	60′	61′		

TABLE 34

Logarithms of the Apparent Altitudes and Horizontal Parallax.

Apparent Altitude 31°									Apparent Altitude 32°									′ or ″	P.P. to ″ of Par.
Moon's Horizontal Parallax.									Moon's Horizontal Parallax.										
53′	54′	55′	56′	57′	58′	59′	60′	61′	53′	54′	55′	56′	57′	58′	59′	60′	61′		
0 ·8192	8111	8031	7953	7876	7800	7726	7653	7581	0 ·8068	7987	7907	7829	7752	7676	7602	7529	7457	0	—0
·8189	8108	8028	7950	7873	7797	7723	7650	7578	·8066	7985	7905	7827	7750	7674	7600	7527	7455	1	1
·8187	8106	8026	7948	7871	7795	7721	7648	7576	·8064	7983	7903	7825	7748	7672	7598	7525	7453	2	3
·8185	8104	8024	7946	7869	7793	7719	7646	7574	·8062	7981	7901	7823	7746	7670	7596	7523	7451	3	4
·8183	8102	8022	7944	7867	7791	7717	7644	7572	·8060	7979	7899	7821	7744	7668	7594	7521	7449	4	5
·8181	8100	8020	7942	7865	7789	7715	7642	7570	·8058	7977	7897	7819	7742	7666	7592	7519	7447	5	6
·8179	8098	8018	7940	7863	7787	7713	7640	7568	·8056	7975	7895	7817	7740	7664	7590	7517	7445	6	8
·8177	8096	8016	7938	7861	7785	7711	7638	7566	·8054	7973	7893	7815	7738	7662	7588	7515	7443	7	9
·8175	8094	8014	7936	7859	7783	7709	7636	7564	·8052	7971	7891	7813	7736	7660	7586	7513	7441	8	10
·8173	8092	8012	7934	7857	7781	7707	7634	7562	·8050	7969	7889	7811	7734	7658	7584	7511	7439	9	11
·8171	8090	8010	7932	7855	7779	7705	7632	7560	·8048	7967	7887	7809	7732	7656	7582	7509	7437	10	13
·8169	8088	8008	7930	7853	7777	7703	7630	7558	·8046	7965	7885	7807	7730	7654	7580	7507	7435	11	14
·8166	8085	8005	7927	7850	7774	7700	7627	7555	·8044	7963	7883	7805	7728	7652	7578	7505	7433	12	15
·8164	8083	8003	7925	7848	7772	7698	7625	7553	·8042	7961	7881	7803	7726	7650	7576	7503	7431	13	17
·8162	8081	8001	7923	7846	7770	7696	7623	7551	·8040	7959	7879	7801	7724	7648	7574	7501	7429	14	18
·8160	8079	7999	7921	7844	7768	7694	7621	7549	·8038	7957	7877	7799	7722	7646	7572	7499	7427	15	19
·8158	8077	7997	7919	7842	7766	7692	7619	7547	·8036	7955	7875	7797	7720	7644	7570	7497	7425	16	20
·8156	8075	7995	7917	7840	7764	7690	7617	7545	·8034	7953	7873	7795	7718	7642	7568	7495	7423	17	22
·8154	8073	7993	7915	7838	7762	7688	7615	7553	·8032	7951	7871	7793	7716	7640	7566	7493	7421	18	23
·8152	8071	7991	7913	7836	7760	7686	7613	7541	·8030	7949	7869	7791	7714	7638	7564	7491	7419	19	24
·8150	8069	7989	7911	7834	7758	7684	7611	7539	·8028	7947	7867	7789	7712	7636	7562	7489	7417	20	25
·8148	8067	7987	7909	7832	7756	7682	7609	7537	·8026	7945	7865	7787	7710	7634	7560	7487	7415	21	27
·8146	8065	7985	7907	7830	7754	7680	7607	7535	·8024	7943	7863	7785	7708	7632	7558	7485	7413	22	28
·8144	8063	7983	7905	7828	7752	7678	7605	7533	·8022	7941	7861	7783	7706	7630	7556	7483	7411	23	29
·8142	8061	7981	7903	7826	7750	7676	7603	7531	·8020	7939	7859	7781	7704	7628	7554	7481	7409	24	30
·8139	8058	7978	7900	7823	7747	7673	7600	7528	·8018	7937	7857	7779	7702	7626	7552	7479	7407	25	32
·8137	8056	7976	7898	7821	7745	7671	7598	7526	·8016	7935	7855	7777	7700	7624	7550	7477	7405	26	33
·8135	8054	7974	7896	7819	7743	7669	7596	7524	·8014	7933	7853	7775	7698	7622	7548	7475	7403	27	34
·8133	8052	7972	7894	7817	7741	7667	7594	7522	·8012	7931	7851	7773	7696	7620	7546	7473	7401	28	35
·8131	8050	7970	7892	7815	7739	7665	7592	7520	·8010	7929	7849	7771	7694	7618	7544	7471	7399	29	37
·8129	8048	7968	7890	7813	7737	7663	7590	7518	·8008	7927	7847	7769	7692	7616	7542	7469	7397	30	38
·8127	8046	7966	7888	7811	7735	7661	7588	7516	·8006	7925	7845	7767	7690	7614	7540	7467	7395	31	39
·8125	8044	7964	7886	7809	7733	7659	7586	7514	·8004	7923	7843	7765	7688	7612	7538	7465	7393	32	41
·8123	8042	7962	7884	7807	7731	7657	7584	7512	·8002	7921	7841	7763	7686	7610	7536	7463	7391	33	42
·8121	8040	7960	7882	7805	7729	7655	7582	7510	·8000	7919	7839	7761	7684	7608	7534	7461	7389	34	43
·8119	8038	7858	7880	7803	7727	7653	7580	7508	·7998	7917	7837	7759	7682	7606	7532	7459	7387	35	44
·8117	8036	7956	7878	7801	7725	7651	7578	7506	·7996	7915	7835	7757	7680	7604	7530	7457	7385	36	45
·8115	8034	7954	7876	7799	7723	7649	7576	7504	·7994	7913	7833	7755	7678	7602	7528	7455	7383	37	47
·8113	8032	7952	7874	7797	7721	7647	7574	7502	·7992	7911	7831	7753	7676	7600	7526	7453	7381	38	48
·8111	8030	7950	7872	7795	7719	7645	7572	7500	·7990	7909	7829	7751	7674	7598	7524	7451	7379	39	49
·8109	8028	7948	7870	7793	7717	7643	7570	7498	·7988	7907	7827	7749	7672	7596	7522	7449	7377	40	51
·8107	8026	7946	7868	7791	7715	7641	7568	7496	·7986	7905	7825	7747	7670	7594	7520	7447	7375	41	52
·8105	8024	7944	7866	7789	7713	7639	7566	7494	·7984	7903	7823	7745	7668	7592	7518	7445	7373	42	53
·8102	8021	7941	7863	7786	7710	7636	7563	7491	·7982	7901	7821	7743	7666	7590	7516	7443	7371	43	54
·8100	8019	7939	7861	7784	7708	7634	7561	7489	·7980	7899	7819	7741	7664	7588	7514	7441	7369	44	56
·8098	8017	7937	7859	7782	7706	7632	7559	7487	·7978	7897	7817	7739	7662	7586	7512	7439	7367	45	57
·8096	8015	7935	7857	7780	7704	7630	7557	7485	·7976	7895	7815	7737	7660	7584	7510	7437	7365	46	58
·8094	8013	7933	7855	7778	7702	7628	7555	7483	·7974	7893	7813	7735	7658	7582	7508	7435	7363	47	59
·8092	8011	7931	7853	7776	7700	7626	7553	7481	·7972	7891	7811	7733	7656	7580	7506	7433	7361	48	61
·8090	8009	7929	7851	7774	7698	7624	7551	7479	·7970	7889	7809	7731	7654	7578	7504	7431	7359	49	62
·8088	8007	7927	7849	7772	7696	7622	7549	7477	·7968	7887	7807	7729	7652	7576	7502	7429	7357	50	63
·8086	8005	7925	7847	7770	7694	7620	7547	7475	·7966	7885	7805	7727	7650	7574	7500	7427	7355	51	64
·8084	8003	7923	7845	7768	7692	7618	7545	7473	·7965	7884	7804	7726	7649	7573	7499	7426	7354	52	66
·8082	8001	7921	7843	7766	7690	7616	7543	7471	·7963	7882	7802	7724	7647	7571	7497	7424	7352	53	67
·8080	7999	7919	7841	7764	7688	7614	7541	7469	·7961	7880	7800	7722	7645	7569	7495	7422	7350	54	68
·8078	7997	7917	7839	7762	7686	7612	7539	7467	·7959	7878	7798	7720	7643	7567	7493	7420	7348	55	69
·8076	7995	7915	7837	7760	7684	7610	7537	7465	·7957	7876	7796	7718	7641	7565	7491	7418	7346	56	71
·8074	7993	7913	7835	7758	7682	7608	7535	7463	·7955	7874	7794	7716	7639	7563	7489	7416	7344	57	72
·8072	7991	7911	7833	7756	7680	7606	7533	7461	·7953	7872	7792	7714	7637	7561	7487	7414	7342	58	73
·8070	7989	7909	7831	7754	7678	7604	7531	7459	·7951	7870	7790	7712	7635	7559	7485	7412	7340	59	74
53′	54′	55′	56′	57′	58′	59′	60′	61′	53′	54′	55′	56′	57′	58′	59′	60′	61′		

TABLE 34

Logarithms of the Apparent Altitudes and Horizontal Parallax.

	Apparent Altitude 33°									Apparent Altitude 34°									
	Moon's Horizontal Parallax.									Moon's Horizontal Parallax.									
′	53′	54′	55′	56′	57′	58′	59′	60′	61′	53′	54′	55′	56′	57′	58′	59′	60′	61′	′ or ″
0	0 ·7949	7868	7788	7710	7633	7557	7483	7410	7338	0 ·7834	7753	7673	7595	7518	7442	7368	7295	7223	0
1	·7947	7866	7786	7708	7631	7555	7481	7408	7336	·7833	7752	7672	7594	7517	7441	7367	7294	7222	1
2	·7945	7864	7784	7706	7629	7553	7479	7406	7334	·7831	7750	7670	7592	7515	7439	7365	7292	7220	2
3	·7943	7862	7782	7704	7627	7551	7477	7404	7332	·7829	7748	7668	7590	7513	7437	7363	7290	7218	3
4	·7941	7860	7780	7702	7625	7549	7475	7402	7330	·7827	7746	7666	7588	7511	7435	7361	7288	7216	4
5	·7939	7858	7778	7700	7623	7547	7473	7400	7328	·7825	7744	7664	7586	7509	7433	7359	7286	7214	5
6	·7937	7856	7776	7698	7621	7545	7471	7398	7326	·7823	7742	7662	7584	7507	7431	7357	7284	7212	6
7	·7935	7854	7774	7696	7619	7543	7469	7396	7324	·7821	7740	7660	7582	7505	7429	7355	7282	7210	7
8	·7933	7852	7772	7694	7617	7541	7467	7394	7322	·7819	7738	7658	7580	7503	7427	7353	7280	7208	8
9	·7931	7850	7770	7692	7615	7539	7465	7392	7320	·7818	7737	7656	7578	7501	7425	7351	7278	7206	9
10	·7930	7849	7769	7691	7614	7538	7464	7391	7319	·7816	7735	7654	7576	7499	7423	7349	7276	7204	10
11	·7928	7847	7767	7689	7612	7536	7462	7389	7317	·7814	7733	7652	7574	7497	7421	7347	7274	7202	11
12	·7926	7845	7765	7687	7610	7534	7460	7387	7315	·7812	7731	7651	7573	7496	7420	7346	7273	7201	12
13	·7924	7843	7763	7685	7608	7532	7458	7385	7313	·7810	7729	7649	7571	7494	7418	7344	7271	7199	13
14	·7922	7841	7761	7683	7606	7530	7456	7383	7311	·7808	7727	7647	7569	7492	7416	7342	7269	7197	14
15	·7920	7839	7759	7681	7604	7528	7454	7381	7309	·7806	7725	7645	7567	7490	7414	7340	7267	7195	15
16	·7918	7837	7757	7679	7602	7526	7452	7379	7307	·7805	7724	7644	7566	7489	7413	7339	7266	7194	16
17	·7916	7835	7755	7677	7600	7524	7450	7377	7305	·7803	7722	7642	7564	7487	7411	7337	7264	7192	17
18	·7914	7833	7753	7675	7598	7522	7448	7375	7303	·7801	7720	7640	7562	7485	7409	7335	7262	7190	18
19	·7912	7831	7751	7673	7596	7520	7446	7373	7301	·7799	7718	7638	7560	7483	7407	7333	7260	7188	19
20	·7910	7829	7749	7671	7594	7518	7444	7371	7299	·7797	7716	7636	7558	7481	7405	7331	7258	7186	20
21	·7908	7827	7747	7669	7592	7516	7442	7369	7297	·7795	7714	7634	7556	7479	7403	7329	7256	7184	21
22	·7906	7825	7745	7667	7590	7514	7440	7367	7295	·7793	7712	7632	7554	7477	7401	7327	7254	7182	22
23	·7904	7823	7743	7665	7588	7512	7438	7365	7293	·7792	7711	7631	7553	7476	7400	7326	7253	7181	23
24	·7903	7822	7742	7664	7587	7511	7437	7364	7292	·7790	7709	7629	7551	7474	7398	7324	7251	7179	24
25	·7901	7820	7740	7662	7585	7509	7435	7362	7290	·7788	7707	7627	7549	7472	7396	7322	7249	7177	25
26	·7899	7818	7738	7660	7583	7507	7433	7360	7288	·7786	7705	7625	7547	7470	7394	7320	7247	7175	26
27	·7897	7816	7736	7658	7581	7505	7431	7358	7286	·7784	7703	7623	7545	7468	7392	7318	7245	7173	27
28	·7895	7814	7734	7656	7579	7503	7429	7356	7284	·7782	7701	7621	7543	7466	7390	7316	7243	7171	28
29	·7893	7812	7732	7654	7577	7501	7427	7354	7282	·7781	7700	7620	7542	7465	7389	7315	7242	7170	29
30	·7891	7810	7730	7652	7575	7499	7425	7352	7280	·7779	7698	7618	7540	7463	7387	7313	7240	7168	30
31	·7889	7808	7728	7650	7573	7497	7423	7350	7278	·7777	7696	7616	7538	7461	7385	7311	7238	7166	31
32	·7887	7806	7726	7648	7571	7495	7421	7348	7276	·7775	7694	7614	7536	7459	7383	7309	7236	7164	32
33	·7885	7804	7724	7646	7569	7493	7419	7346	7274	·7773	7692	7612	7534	7457	7381	7307	7234	7162	33
34	·7883	7802	7722	7644	7567	7491	7417	7344	7272	·7771	7690	7610	7532	7455	7379	7305	7232	7160	34
35	·7882	7801	7721	7643	7566	7490	7416	7343	7271	·7770	7689	7609	7531	7454	7378	7304	7231	7159	35
36	·7880	7799	7719	7641	7564	7488	7414	7341	7269	·7768	7687	7607	7529	7452	7376	7302	7229	7157	36
37	·7878	7797	7717	7639	7562	7486	7412	7339	7267	·7766	7685	7605	7527	7450	7374	7300	7227	7155	37
38	·7876	7795	7715	7637	7560	7484	7410	7337	7265	·7764	7683	7603	7525	7448	7372	7298	7225	7153	38
39	·7874	7793	7713	7635	7558	7482	7408	7335	7263	·7762	7681	7601	7523	7446	7370	7296	7223	7151	39
40	·7872	7791	7711	7633	7556	7480	7406	7333	7261	·7760	7679	7599	7521	7444	7368	7294	7221	7149	40
41	·7870	7789	7709	7631	7554	7478	7404	7331	7259	·7759	7678	7598	7520	7443	7367	7293	7220	7148	41
42	·7868	7787	7707	7629	7552	7476	7402	7329	7257	·7757	7676	7596	7518	7441	7365	7291	7218	7146	42
43	·7866	7785	7705	7627	7550	7474	7400	7327	7255	·7755	7674	7594	7516	7439	7363	7289	7216	7144	43
44	·7864	7783	7703	7625	7548	7472	7398	7325	7253	·7753	7672	7592	7514	7437	7361	7287	7214	7142	44
45	·7863	7782	7702	7624	7547	7471	7397	7324	7252	·7751	7670	7590	7512	7435	7359	7285	7212	7140	45
46	·7861	7780	7700	7622	7545	7469	7395	7322	7250	·7749	7668	7588	7510	7433	7357	7283	7210	7138	46
47	·7859	7778	7698	7620	7543	7467	7393	7320	7248	·7748	7667	7587	7509	7432	7356	7282	7209	7137	47
48	·7857	7776	7696	7618	7541	7465	7391	7318	7246	·7746	7665	7585	7507	7430	7354	7280	7207	7135	48
49	·7855	7774	7694	7616	7539	7463	7389	7316	7244	·7744	7663	7583	7505	7428	7352	7278	7205	7133	49
50	·7853	7772	7692	7614	7537	7461	7387	7314	7242	·7742	7661	7581	7503	7426	7350	7276	7203	7131	50
51	·7851	7770	7690	7612	7535	7459	7385	7312	7240	·7740	7659	7579	7501	7424	7348	7274	7201	7129	51
52	·7849	7768	7688	7610	7533	7457	7383	7310	7238	·7739	7658	7578	7500	7423	7347	7273	7200	7128	52
53	·7848	7767	7687	7609	7532	7456	7382	7309	7237	·7737	7656	7576	7498	7421	7345	7271	7198	7126	53
54	·7846	7765	7685	7607	7530	7454	7380	7307	7235	·7735	7654	7574	7496	7419	7343	7269	7196	7124	54
55	·7844	7763	7683	7605	7528	7452	7378	7305	7233	·7733	7652	7572	7494	7417	7341	7267	7194	7122	55
56	·7842	7761	7681	7603	7526	7450	7376	7303	7231	·7731	7650	7570	7492	7415	7339	7265	7192	7120	56
57	·7840	7759	7679	7601	7524	7448	7374	7301	7229	·7729	7648	7568	7490	7413	7337	7263	7190	7118	57
58	·7838	7757	7677	7599	7522	7446	7372	7299	7227	·7728	7647	7567	7489	7412	7336	7262	7189	7117	58
59	·7836	7755	7675	7597	7520	7444	7370	7297	7225	·7726	7645	7565	7487	7410	7334	7260	7187	7115	59

TABLE 34

Logarithms of the Apparent Altitudes and Horizontal Parallax.

Apparent Altitude 35°									Apparent Altitude 36°									′ or ″	P.P. to ″ of Par.
Moon's Horizontal Parallax.									Moon's Horizontal Parallax.										
53′	54′	55′	56′	57′	58′	59′	60′	61′	53′	54′	55′	56′	57′	58′	59′	60′	61′		
·7724	7643	7563	7485	7408	7332	7258	7185	7113	0·7618	7537	7457	7379	7302	7226	7152	7079	7007	0	– 0
·7722	7641	7561	7483	7406	7330	7256	7183	7111	·7616	7535	7455	7377	7300	7224	7150	7077	7005	1	1
·7720	7639	7559	7481	7404	7328	7254	7181	7109	·7614	7533	7453	7375	7298	7222	7148	7075	7003	2	3
·7719	7638	7558	7480	7403	7327	7253	7180	7108	·7613	7532	7452	7374	7297	7221	7147	7074	7002	3	4
·7717	7636	7556	7478	7401	7325	7251	7178	7106	·7611	7530	7450	7372	7295	7219	7145	7072	7000	4	5
·7715	7634	7554	7476	7399	7323	7249	7176	7104	·7609	7528	7448	7370	7293	7217	7143	7070	6998	5	6
·7713	7632	7552	7474	7397	7321	7247	7174	7102	·7607	7526	7446	7368	7291	7215	7141	7068	6996	6	8
·7711	7630	7550	7472	7395	7319	7245	7172	7100	·7606	7525	7445	7367	7290	7214	7140	7067	6995	7	9
·7710	7629	7549	7471	7394	7318	7244	7171	7099	·7604	7523	7443	7365	7288	7212	7138	7065	6993	8	10
·7708	7627	7547	7469	7392	7316	7242	7169	7097	·7602	7521	7441	7363	7286	7210	7136	7063	6991	9	11
·7706	7625	7545	7467	7390	7314	7240	7167	7095	·7600	7519	7439	7361	7284	7208	7134	7061	6989	10	13
·7704	7623	7543	7465	7388	7312	7238	7165	7093	·7599	7518	7438	7360	7283	7207	7133	7060	6988	11	14
·7703	7622	7542	7464	7387	7311	7237	7164	7092	·7597	7516	7436	7358	7281	7205	7131	7058	6986	12	15
·7701	7620	7540	7462	7385	7309	7235	7162	7090	·7595	7514	7434	7356	7279	7203	7129	7056	6984	13	17
·7699	7618	7538	7460	7383	7307	7233	7160	7088	·7594	7513	7433	7355	7278	7202	7128	7055	6983	14	18
·7697	7616	7536	7458	7381	7305	7231	7158	7086	·7592	7511	7431	7353	7276	7200	7126	7053	6981	15	19
·7695	7614	7534	7456	7379	7303	7229	7156	7084	·7590	7509	7429	7351	7274	7198	7124	7051	6979	16	20
·7694	7613	7533	7455	7378	7302	7228	7155	7083	·7588	7507	7427	7349	7272	7196	7122	7049	6977	17	22
·7692	7611	7531	7453	7376	7300	7226	7153	7081	·7587	7506	7426	7348	7271	7195	7121	7048	6976	18	23
·7690	7609	7529	7451	7374	7298	7224	7151	7079	·7585	7504	7424	7346	7269	7193	7119	7046	6974	19	24
·7688	7607	7527	7449	7372	7296	7222	7149	7077	·7583	7502	7422	7344	7267	7191	7117	7044	6972	20	25
·7686	7605	7525	7447	7370	7294	7220	7147	7075	·7582	7501	7421	7343	7266	7190	7116	7043	6971	21	27
·7685	7604	7524	7446	7369	7293	7219	7146	7074	·7580	7499	7419	7341	7264	7188	7114	7041	6969	22	28
·7683	7602	7522	7444	7367	7291	7217	7144	7072	·7578	7497	7417	7339	7262	7186	7112	7039	6967	23	29
·7681	7600	7520	7442	7365	7289	7215	7142	7070	·7576	7495	7415	7337	7260	7184	7110	7037	6965	24	30
·7679	7598	7518	7440	7363	7287	7213	7140	7068	·7575	7494	7414	7336	7259	7183	7109	7036	6964	25	32
·7678	7597	7517	7439	7362	7286	7212	7139	7067	·7573	7492	7412	7334	7257	7181	7107	7034	6962	26	33
·7676	7595	7515	7437	7360	7284	7210	7137	7065	·7571	7490	7410	7332	7255	7179	7105	7032	6960	27	34
·7674	7593	7513	7435	7358	7282	7208	7135	7063	·7570	7489	7409	7331	7254	7178	7104	7031	6659	28	35
·7672	7591	7511	7433	7356	7280	7206	7133	7061	·7568	7487	7407	7329	7252	7176	7102	7029	6957	29	37
·7670	7589	7509	7431	7354	7278	7204	7131	7059	·7566	7485	7405	7327	7250	7174	7100	7027	6955	30	38
·7669	7588	7508	7430	7353	7277	7203	7130	7058	·7564	7483	7403	7325	7248	7172	7098	7025	6953	31	39
·7667	7586	7506	7428	7351	7275	7201	7128	7056	·7563	7482	7402	7324	7247	7171	7097	7024	6952	32	41
·7665	7584	7504	7426	7349	7273	7199	7126	7054	·7561	7480	7400	7322	7245	7169	7095	7022	6950	33	42
·7663	7582	7502	7424	7347	7271	7197	7124	7052	·7559	7478	7398	7320	7243	7167	7093	7020	6948	34	43
·7662	7581	7501	7423	7346	7270	7196	7123	7051	·7558	7477	7397	7319	7242	7166	7092	7019	6947	35	44
·7660	7579	7499	7421	7344	7268	7194	7121	7049	·7556	7475	7395	7317	7240	7164	7090	7017	6945	36	45
·7658	7577	7497	7419	7342	7266	7192	7119	7047	·7554	7473	7393	7315	7238	7162	7088	7015	6943	37	47
·7656	7575	7495	7417	7340	7264	7190	7117	7045	·7552	7471	7391	7313	7236	7160	7086	7013	6941	38	48
·7655	7574	7494	7416	7338	7262	7188	7115	7043	·7551	7470	7390	7312	7235	7159	7085	7012	6940	39	49
·7653	7572	7492	7414	7337	7261	7187	7114	7042	·7549	7468	7388	7310	7233	7157	7083	7010	6938	40	51
·7651	7570	7490	7412	7335	7259	7185	7112	7040	·7547	7466	7386	7308	7231	7155	7082	7009	6937	41	52
·7649	7568	7488	7410	7333	7257	7183	7110	7038	·7546	7465	7385	7307	7230	7154	7080	7007	6935	42	53
·7648	7567	7487	7409	7332	7256	7182	7109	7037	·7544	7463	7383	7305	7228	7152	7078	7005	6933	43	54
·7646	7565	7485	7407	7330	7254	7180	7107	7035	·7542	7461	7381	7303	7226	7150	7076	7003	6931	44	56
·7644	7563	7483	7405	7328	7252	7178	7105	7033	·7541	7460	7380	7302	7225	7149	7075	7002	6930	45	57
·7642	7561	7481	7403	7326	7250	7176	7103	7031	·7539	7458	7378	7300	7223	7147	7073	7000	6928	46	58
·7641	7560	7480	7402	7325	7249	7175	7102	7030	·7537	7456	7376	7298	7221	7145	7071	6998	6926	47	59
·7639	7558	7478	7400	7323	7247	7173	7100	7028	·7536	7455	7375	7297	7220	7144	7070	6997	6925	48	61
·7637	7556	7476	7398	7321	7245	7171	7098	7026	·7534	7453	7373	7295	7218	7142	7068	6995	6923	49	62
·7635	7554	7474	7396	7319	7243	7169	7096	7024	·7532	7451	7371	7293	7216	7140	7066	6993	6921	50	63
·7634	7553	7473	7395	7318	7242	7168	7095	7023	·7530	7449	7369	7291	7214	7138	7064	6991	6920	51	64
·7632	7551	7471	7393	7316	7240	7166	7093	7021	·7529	7448	7368	7290	7213	7137	7063	6990	6918	52	66
·7630	7549	7469	7391	7314	7238	7164	7091	7019	·7527	7446	7366	7288	7211	7135	7061	6988	6916	53	67
·7628	7547	7467	7389	7312	7236	7162	7089	7017	·7525	7444	7364	7286	7209	7133	7059	6986	6914	54	68
·7627	7546	7466	7388	7311	7235	7161	7088	7016	·7524	7443	7363	7285	7208	7132	7058	6985	6913	55	69
·7625	7544	7464	7386	7309	7233	7159	7086	7014	·7522	7441	7361	7283	7206	7130	7056	6983	6911	56	71
·7623	7542	7462	7384	7307	7231	7157	7084	7012	·7520	7439	7359	7281	7204	7128	7054	6981	6909	57	72
·7621	7540	7460	7382	7305	7229	7155	7082	7010	·7519	7438	7358	7280	7203	7127	7053	6980	6908	58	73
·7620	7539	7459	7381	7304	7228	7154	7081	7009	·7517	7436	7356	7278	7201	7125	7051	6978	6906	59	74
53′	54′	55′	56′	57′	58′	59′	60′	61′	53′	54′	55′	56′	57′	58′	59′	60′	61′		

TABLE 34

Logarithms of the Apparent Altitudes and Horizontal Parallax

	Apparent Altitude 37°								
	Moon's Horizontal Parallax.								
′	53′	54′	55′	56′	57′	58′	59′	60′	61′
0	0·7515	7434	7354	7276	7199	7123	7049	6976	6904
1	·7514	7433	7353	7275	7198	7122	7048	6975	6903
2	·7512	7431	7351	7273	7196	7120	7046	6973	6901
3	·7510	7429	7349	7271	7194	7118	7044	6971	6899
4	·7508	7427	7347	7269	7192	7116	7042	6969	6897
5	·7506	7425	7345	7267	7190	7114	7040	6967	6895
6	·7505	7424	7344	7266	7189	7113	7039	6966	6894
7	·7504	7422	7343	7265	7188	7112	7038	6965	6893
8	·7502	7421	7341	7263	7186	7110	7036	6963	6891
9	·7500	7419	7339	7261	7184	7108	7034	6961	6889
10	·7499	7418	7338	7260	7183	7107	7033	6960	6888
11	·7497	7416	7336	7258	7181	7105	7031	6958	6886
12	·7495	7414	7334	7256	7180	7103	7029	6956	6884
13	·7494	7413	7333	7255	7178	7102	7028	6955	6883
14	·7492	7411	7331	7253	7176	7100	7026	6953	6881
15	·7490	7409	7329	7251	7174	7098	7024	6951	6879
16	·7489	7408	7328	7250	7173	7097	7023	6950	6878
17	·7487	7406	7326	7248	7171	7095	7021	6948	6876
18	·7485	7404	7324	7246	7170	7093	7019	6946	6874
19	·7484	7403	7323	7245	7168	7092	7018	6945	6873
20	·7482	7401	7321	7243	7166	7090	7016	6943	6871
21	·7480	7399	7319	7241	7164	7088	7014	6941	6869
22	·7479	7398	7318	7240	7163	7087	7013	6940	6868
23	·7477	7396	7316	7238	7161	7085	7011	6938	6866
24	·7475	7394	7314	7236	7159	7083	7009	6936	6864
25	·7474	7393	7313	7235	7158	7082	7008	6935	6863
26	·7472	7391	7311	7233	7156	7080	7006	6933	6861
27	·7470	7389	7309	7231	7154	7078	7004	6931	6859
28	·7469	7388	7308	7230	7153	7077	7003	6930	6858
29	·7467	7386	7306	7228	7151	7075	7001	6928	6856
30	·7466	7385	7305	7227	7150	7074	7000	6927	6855
31	·7464	7383	7303	7225	7148	7072	6998	6925	6853
32	·7462	7381	7301	7223	7146	7070	6996	6923	6851
33	·7461	7380	7300	7222	7145	7069	6995	6922	6850
34	·7459	7378	7298	7220	7143	7067	6993	6920	6848
35	·7457	7376	7296	7218	7141	7065	6991	6918	6846
36	·7456	7375	7295	7217	7140	7064	6990	6917	6845
37	·7454	7373	7293	7215	7138	7062	6988	6915	6843
38	·7452	7371	7291	7213	7136	7060	6986	6913	6841
39	·7451	7370	7290	7212	7135	7059	6985	6912	6840
40	·7449	7368	7288	7210	7133	7057	6983	6910	6838
41	·7447	7366	7286	7208	7131	7055	6981	6908	6836
42	·7446	7365	7285	7207	7130	7054	6980	6907	6835
43	·7444	7363	7283	7205	7128	7052	6978	6905	6833
44	·7443	7362	7282	7204	7127	7051	6977	6904	6832
45	·7441	7360	7280	7202	7125	7049	6975	6902	6830
46	·7439	7358	7278	7200	7123	7047	6973	6900	6828
47	·7438	7357	7277	7199	7122	7046	6972	6898	6826
48	·7436	7355	7275	7197	7120	7044	6970	6897	6825
49	7434	7353	7273	7195	7118	7042	6968	6895	6823
50	·7433	7352	7272	7194	7117	7041	6967	6894	6822
51	·7431	7350	7270	7192	7115	7039	6965	6892	6820
52	·7430	7349	7269	7191	7114	7038	6964	6891	6819
53	·7428	7347	7267	7189	7112	7036	6962	6889	6817
54	·7426	7345	7265	7187	7110	7034	6960	6887	6815
55	·7425	7344	7264	7186	7109	7033	6959	6886	6814
56	·7423	7342	7262	7184	7107	7031	6957	6884	6812
57	·7421	7340	7260	7182	7105	7029	6955	6882	6810
58	·7420	7339	7259	7180	7104	7028	6954	6881	6809
59	·7418	7337	7257	7179	7102	7026	6952	6879	6807
	53′	54′	55′	56′	57′	58′	59′	60′	61′

Apparent Altitude 38°									
Moon's Horizontal Parallax.									″ or ′
53′	54′	55′	56′	57′	58′	59′	60′	61′	
0·7417	7336	7256	7178	7101	7025	6951	6878	6806	0
·7415	7334	7254	7176	7099	7023	6949	6876	6804	1
·7413	7332	7252	7174	7097	7021	6947	6874	6802	2
·7412	7331	7251	7173	7096	7020	6946	6872	6800	3
·7410	7329	7249	7171	7094	7018	6944	6871	6799	4
·7409	7328	7248	7170	7093	7017	6943	6870	6798	5
·7407	7326	7246	7168	7091	7015	6941	6868	6796	6
·7405	7324	7244	7166	7089	7013	6939	6866	6794	7
·7404	7323	7243	7165	7088	7012	6938	6865	6793	8
·7402	7321	7241	7163	7086	7010	6936	6863	6791	9
·7400	7319	7239	7161	7084	7008	6934	6861	6789	10
·7399	7318	7238	7160	7083	7007	6933	6860	6788	11
·7397	7316	7236	7158	7081	7005	6931	6858	6786	12
·7396	7315	7235	7157	7080	7004	6930	6857	6785	13
·7394	7313	7233	7155	7078	7002	6928	6855	6783	14
·7392	7311	7231	7153	7076	7000	6926	6853	6781	15
·7391	7310	7230	7152	7075	6999	6925	6852	6780	16
·7389	7308	7228	7150	7073	6997	6923	6850	6778	17
·7388	7307	7227	7149	7072	6996	6922	6849	6777	18
·7386	7305	7225	7147	7070	6994	6920	6847	6775	19
·7384	7303	7223	7145	7068	6992	6918	6845	6773	20
·7383	7302	7222	7144	7067	6991	6917	6844	6772	21
·7381	7300	7220	7142	7065	6989	6915	6842	6770	22
·7380	7299	7219	7141	7064	6988	6914	6840	6768	23
·7378	7297	7217	7139	7062	6986	6912	6839	6767	24
·7376	7295	7215	7137	7060	6984	6910	6837	6765	25
·7375	7294	7214	7136	7059	6983	6909	6836	6764	26
·7373	7292	7212	7134	7057	6981	6907	6834	6762	27
·7372	7291	7211	7133	7056	6980	6906	6833	6761	28
·7370	7289	7209	7131	7054	6978	6904	6831	6759	29
·7368	7287	7207	7129	7052	6976	6902	6829	6757	30
·7367	7286	7206	7128	7051	6975	6901	6828	6756	31
·7365	7284	7204	7126	7049	6973	6899	6826	6754	32
·7364	7283	7203	7125	7048	6972	6898	6825	6753	33
·7362	7281	7201	7123	7046	6970	6896	6823	6751	34
·7361	7280	7200	7122	7045	6969	6895	6822	6750	35
·7359	7278	7198	7120	7043	6967	6893	6820	6748	36
·7357	7276	7196	7118	7041	6965	6891	6818	6746	37
·7356	7275	7195	7117	7040	6964	6890	6817	6745	38
·7354	7273	7193	7115	7038	6962	6888	6815	6743	39
·7353	7272	7192	7114	7037	6961	6887	6814	6742	40
·7351	7270	7190	7112	7035	6959	6885	6812	6740	41
·7350	7269	7189	7111	7034	6958	6884	6811	6739	42
·7348	7267	7187	7109	7032	6956	6882	6809	6737	43
·7346	7265	7185	7107	7030	6954	6880	6807	6735	44
·7345	7264	7184	7106	7029	6953	6879	6806	6734	45
·7343	7262	7182	7104	7027	6951	6877	6804	6732	46
·7342	7261	7181	7103	7026	6950	6876	6803	6731	47
·7340	7259	7179	7101	7024	6948	6874	6801	6729	48
·7338	7257	7177	7099	7022	6946	6872	6799	6727	49
·7337	7256	7176	7098	7021	6945	6871	6798	6726	50
·7335	7254	7174	7096	7019	6943	6869	6796	6724	51
·7334	7253	7173	7095	7018	6942	6868	6795	6723	52
·7332	7251	7171	7093	7016	6940	6866	6793	6721	53
·7331	7250	7170	7092	7015	6939	6865	6792	6720	54
·7329	7248	7168	7090	7013	6937	6863	6790	6718	55
·7328	7247	7167	7089	7012	6936	6862	6789	6717	56
·7326	7245	7165	7087	7010	6934	6860	6787	6715	57
·7324	7243	7163	7085	7008	6932	6858	6785	6713	58
·7323	7242	7162	7084	7007	6931	6857	6784	6712	59
53′	54′	55′	56′	57′	58′	59′	60′	61′	

TABLE 34

Logarithms of the Apparent Altitudes and Horizontal Parallax.

Apparent Altitude 39°									Apparent Altitude 40°									″ or ′	P.P. to ″ of Par.
Moon's Horizontal Parallax.									Moon's Horizontal Parallax.										
53′	54′	55′	56′	57′	58′	59′	60′	61′	53′	54′	55′	56′	57′	58′	59′	60′	61′		
·7321	7240	7160	7082	7005	6929	6855	6782	6710	0·7229	7148	7068	6990	6913	6837	6763	6690	6618	0	—0
·7320	7239	7159	7081	7004	6927	6854	6781	6709	·7228	7147	7067	6989	6912	6836	6762	6689	6617	1	1
·7318	7237	7157	7079	7002	6926	6852	6779	6707	·7226	7145	7065	6987	6910	6834	6760	6687	6615	2	3
·7317	7236	7156	7078	7001	6925	6851	6778	6706	·7225	7144	7064	6986	6909	6833	6759	6686	6614	3	4
·7315	7234	7154	7076	6999	6923	6849	6776	6704	·7223	7142	7062	6984	6907	6831	6757	6684	6612	4	5
·7313	7232	7152	7074	6997	6921	6847	6774	6702	·7222	7141	7061	6983	6906	6830	6756	6682	6610	5	6
·7312	7231	7151	7073	6996	6920	6846	6773	6701	·7220	7139	7059	6981	6904	6828	6754	6681	6609	6	8
·7310	7229	7149	7071	6994	6918	6844	6771	6699	·7219	7138	7058	6980	6903	6827	6753	6680	6608	7	9
·7309	7227	7147	7069	6992	6916	6842	6769	6697	·7217	7136	7056	6978	6901	6825	6751	6678	6606	8	10
·7307	7226	7146	7068	6991	6915	6841	6768	6696	·7216	7135	7055	6977	6900	6824	6750	6677	6605	9	11
·7306	7225	7145	7067	6990	6914	6840	6767	6695	·7214	7133	7053	6975	6898	6822	6748	6675	6603	10	13
·7304	7223	7143	7065	6988	6912	6838	6765	6693	·7213	7132	7052	6974	6897	6821	6747	6673	6601	11	14
·7303	7222	7142	7064	6987	6911	6837	6764	6692	·7211	7130	7050	6972	6895	6819	6745	6672	6600	12	15
·7301	7220	7140	7062	6985	6909	6835	6762	6690	·7210	7129	7049	6971	6894	6818	6744	6671	6599	13	17
·7300	7219	7139	7061	6984	6908	6834	6761	6689	·7208	7127	7047	6969	6892	6816	6742	6669	6597	14	18
·7298	7217	7137	7059	6982	6906	6832	6759	6687	·7207	7126	7046	6968	6891	6815	6741	6668	6596	15	19
·7296	7215	7135	7057	6980	6904	6830	6757	6685	·7206	7125	7045	6967	6890	6814	6740	6667	6595	16	20
·7295	7214	7134	7056	6979	6903	6829	6756	6684	·7204	7123	7043	6965	6888	6812	6738	6665	6593	17	22
·7293	7212	7132	7054	6977	6901	6827	6754	6682	·7202	7121	7041	6963	6886	6810	6736	6663	6591	18	23
·7292	7211	7131	7053	6976	6900	6826	6753	6681	·7201	7120	7040	6962	6885	6809	6735	6662	6590	19	24
·7290	7209	7129	7051	6974	6898	6824	6751	6679	·7199	7119	7039	6961	6884	6808	6734	6661	6589	20	25
·7289	7208	7128	7050	6973	6897	6823	6750	6678	·7198	7117	7037	6959	6882	6806	6732	6659	6587	21	27
·7287	7206	7126	7048	6971	6895	6821	6748	6676	·7196	7115	7035	6957	6880	6804	6730	6657	6585	22	28
·7286	7205	7125	7047	6970	6894	6820	6747	6675	·7195	7114	7034	6956	6879	6803	6729	6656	6584	23	29
·7284	7203	7123	7045	6968	6892	6818	6745	6673	·7193	7112	7032	6954	6877	6801	6727	6654	6582	24	30
·7283	7202	7122	7044	6967	6891	6817	6744	6672	·7192	7111	7031	6953	6876	6800	6726	6653	6581	25	32
·7281	7200	7120	7042	6965	6889	6815	6742	6670	·7190	7110	7030	6952	6875	6799	6725	6652	6580	26	33
·7280	7199	7119	7041	6964	6888	6814	6741	6669	·7189	7108	7028	6950	6873	6797	6723	6650	6579	27	34
·7278	7197	7117	7039	6962	6886	6812	6739	6667	·7188	7107	7027	6949	6872	6796	6722	6649	6577	28	35
·7276	7195	7115	7037	6960	6884	6810	6737	6665	·7186	7105	7025	6947	6870	6794	6721	6647	6575	29	37
·7275	7194	7114	7036	6959	6883	6809	6736	6664	·7185	7104	7024	6946	6869	6793	6719	6646	6574	30	38
·7273	7192	7112	7034	6957	6881	6807	6734	6662	·7183	7102	7022	6944	6867	6791	6717	6644	6572	31	39
·7272	7191	7111	7033	6956	6880	6806	6733	6661	·7182	7101	7021	6943	6866	6790	6716	6643	6571	32	41
·7270	7190	7110	7032	6955	6879	6805	6732	6660	·7180	7099	7019	6941	6864	6788	6714	6641	6569	33	42
·7269	7188	7108	7030	6953	6877	6803	6730	6658	·7179	7098	7018	6940	6863	6787	6713	6640	6568	34	43
·7267	7186	7106	7028	6951	6875	6801	6728	6656	·7177	7096	7016	6938	6861	6785	6711	6638	6566	35	44
·7266	7185	7105	7027	6950	6874	6800	6727	6655	·7176	7095	7015	6937	6860	6784	6710	6637	6565	36	45
·7264	7183	7103	7025	6948	6872	6798	6725	6653	·7174	7093	7013	6935	6858	6782	6708	6635	6563	37	47
·7263	7182	7102	7024	6947	6871	6797	6724	6652	·7173	7092	7012	6934	6857	6781	6707	6634	6562	38	48
·7261	7180	7100	7022	6945	6869	6795	6722	6650	·7171	7090	7010	6932	6855	6779	6705	6632	6560	39	49
·7260	7179	7099	7021	6944	6868	6794	6721	6649	·7170	7089	7009	6931	6854	6778	6704	6631	6559	40	51
·7258	7177	7097	7019	6942	6866	6792	6719	6647	·7168	7087	7007	6929	6852	6776	6702	6629	6557	41	52
·7257	7176	7096	7018	6941	6865	6791	6718	6646	·7167	7086	7006	6928	6851	6775	6701	6628	6556	42	53
·7255	7174	7094	7016	6939	6863	6789	6716	6644	·7165	7084	7004	6926	6849	6773	6699	6626	6554	43	54
·7254	7173	7093	7015	6938	6862	6788	6715	6643	·7164	7083	7003	6925	6848	6772	6698	6625	6553	44	56
·7252	7171	7091	7013	6936	6860	6786	6713	6641	·7162	7081	7001	6923	6846	6770	6696	6623	6551	45	57
·7250	7170	7090	7012	6935	6859	6785	6712	6640	·7161	7080	7000	6922	6845	6769	6695	6622	6550	46	58
·7249	7168	7088	7010	6933	6857	6783	6710	6638	·7160	7079	6999	6921	6844	6768	6694	6621	6549	47	59
·7247	7166	7086	7008	6931	6855	6781	6708	6636	·7158	7077	6997	6919	6842	6766	6692	6619	6547	48	61
·7246	7165	7085	7007	6930	6854	6780	6707	6635	·7157	7076	6996	6918	6841	6765	6691	6618	6546	49	62
·7244	7163	7083	7005	6928	6852	6778	6705	6633	·7155	7074	6994	6916	6839	6763	6689	6616	6544	50	63
·7243	7162	7082	7004	6927	6851	6777	6704	6632	·7154	7073	6993	6915	6838	6762	6688	6615	6543	51	64
·7241	7161	7081	7003	6926	6850	6776	6703	6631	·7152	7071	6991	6913	6836	6760	6686	6613	6541	52	66
·7240	7159	7079	7001	6924	6848	6774	6701	6629	·7151	7070	6990	6912	6835	6759	6685	6612	6540	53	67
·7238	7157	7077	6999	6922	6846	6772	6699	6627	·7150	7068	6988	6910	6833	6757	6683	6610	6538	54	68
·7237	7156	7076	6998	6921	6845	6771	6698	6626	·7148	7067	6987	6909	6832	6756	6682	6609	6537	55	69
·7235	7154	7074	6996	6919	6843	6769	6696	6624	·7146	7065	6985	6907	6830	6754	6680	6607	6535	56	71
·7234	7153	7073	6995	6918	6842	6768	6695	6623	·7145	7064	6984	6906	6829	6753	6679	6606	6534	57	72
·7232	7151	7071	6993	6916	6840	6766	6693	6621	·7143	7062	6982	6904	6827	6751	6677	6604	6532	58	73
·7231	7150	7070	6992	6915	6839	6765	6692	6620	·7142	7061	6981	6903	6826	6750	6676	6603	6531	59	74

TABLE 34

Logarithms of the Apparent Altitudes and Horizontal Parallax.

	Apparent Altitude 41°									Apparent Altitude 42°									
	Moon's Horizontal Parallax.									Moon's Horizontal Parallax.									′ or ″
′	53′	54′	55′	56′	57′	58′	59′	60′	61′	53′	54′	55′	56′	57′	58′	59′	60′	61′	
0	0·7141	7060	6980	6902	6825	6749	6675	6602	6530	0·7055	6974	6894	6816	6739	6663	6589	6516	6444	0
1	·7139	7058	6978	6900	6823	6747	6673	6600	6528	·7053	6972	6892	6814	6737	6661	6587	6514	6442	1
2	·7138	7057	6977	6899	6822	6746	6672	6599	6527	·7052	6971	6891	6813	6736	6660	6586	6513	6441	2
3	·7136	7055	6975	6897	6820	6744	6670	6597	6525	·7051	6970	6890	6812	6735	6659	6585	6512	6440	3
4	·7135	7054	6974	6896	6819	6743	6669	6596	6524	·7049	6968	6888	6810	6733	6657	6583	6510	6438	4
5	·7133	7052	6972	6894	6817	6741	6667	6594	6522	·7048	6967	6887	6809	6732	6656	6582	6508	6436	5
6	·7132	7051	6971	6893	6816	6740	6666	6592	6520	·7046	6965	6885	6807	6730	6654	6580	6507	6435	6
7	·7130	7049	6969	6891	6814	6738	6664	6591	6519	·7045	6964	6884	6806	6729	6653	6579	6506	6434	7
8	·7129	7048	6968	6890	6813	6737	6663	6590	6518	·7044	6963	6883	6805	6728	6652	6578	6505	6433	8
9	·7128	7047	6967	6889	6812	6736	6662	6589	6517	·7042	6961	6881	6803	6726	6650	6576	6503	6431	9
10	.7126	7045	6965	6887	6810	6734	6660	6587	6515	·7041	6960	6880	6802	6725	6649	6575	6502	6430	10
11	7125	7044	6964	6886	6808	6732	6658	6585	6513	·7040	6959	6879	6801	6724	6648	6574	6501	6429	11
12	·7123	7042	6962	6884	6807	6731	6657	6584	6512	·7038	6957	6877	6799	6722	6646	6572	6499	6427	12
13	·7122	7041	6961	6883	6806	6730	6656	6583	6511	·7037	6956	6876	6798	6721	6645	6571	6498	6426	13
14	·7120	7039	6959	6881	6804	6728	6654	6581	6509	·7035	6954	6874	6796	6719	6643	6569	6496	6424	14
15	·7119	7038	6958	6880	6803	6727	6653	6580	6508	·7034	6953	6873	6795	6718	6642	6568	6495	6423	15
16	·7117	7036	6956	6878	6801	6725	6651	6578	6506	·7033	6952	6872	6794	6717	6641	6567	6494	6422	16
17	·7116	7035	6955	6877	6800	6724	6650	6577	6505	·7031	6950	6870	6792	6715	6639	6565	6492	6420	17
18	·7115	7034	6954	6876	6799	6723	6649	6576	6504	·7030	6949	6869	6791	6714	6638	6564	6491	6419	18
19	·7113	7032	6952	6874	6797	6721	6647	6574	6502	·7028	6947	6867	6789	6712	6636	6562	6489	6417	19
20	·7112	7031	6951	6873	6796	6720	6646	6573	6501	·7027	6946	6866	6788	6711	6635	6561	6488	6416	20
21	·7110	7029	6949	6871	6794	6718	6644	6571	6499	·7026	6945	6865	6787	6710	6634	6560	6487	6415	21
22	·7109	7028	6948	6870	6793	6717	6643	6570	6498	·7024	6943	6863	6785	6708	6632	6558	6485	6413	22
23	·7107	7026	6946	6868	6791	6715	6641	6568	6496	·7023	6942	6862	6784	6707	6631	6557	6484	6412	23
24	·7106	7025	6945	6867	6790	6714	6640	6566	6494	·7021	6940	6860	6782	6705	6629	6555	6482	6410	24
25	·7104	7023	6943	6865	6788	6712	6638	6565	6493	·7020	6939	6859	6781	6704	6628	6554	6481	6409	25
26	·7103	7022	6942	6864	6787	6711	6637	6564	6492	·7019	6938	6858	6780	6703	6627	6553	6480	6408	26
27	·7102	7021	6941	6863	6786	6710	6636	6563	6491	·7017	6936	6856	6778	6701	6625	6551	6478	6406	27
28	·7100	7019	6939	6861	6784	6708	6634	6561	6489	·7016	6935	6855	6777	6700	6624	6550	6477	6405	28
29	·7099	7017	6937	6859	6782	6706	6632	6559	6487	·7015	6934	6854	6776	6699	6623	6549	6476	6404	29
30	·7097	7016	6936	6858	6781	6705	6631	6558	6486	·7013	6932	6852	6774	6697	6621	6547	6474	6402	30
31	·7096	7015	6935	6857	6780	6704	6630	6557	6485	·7012	6931	6851	6773	6696	6620	6546	6473	6401	31
32	·7094	7013	6933	6855	6778	6702	6628	6555	6483	·7010	6929	6849	6771	6694	6618	6544	6471	6399	32
33	·7093	7012	6932	6854	6777	6701	6627	6554	6482	·7009	6928	6848	6770	6693	6617	6543	6470	6398	33
34	·7092	7011	6931	6853	6776	6700	6626	6553	6481	·7008	6927	6847	6769	6692	6616	6542	6469	6397	34
35	·7090	7010	6930	6852	6775	6699	6625	6552	6480	·7006	6925	6845	6767	6690	6614	6540	6467	6395	35
36	·7089	7008	6928	6850	6773	6697	6623	6550	6478	·7005	6924	6844	6766	6689	6613	6539	6466	6394	36
37	·7087	7006	6926	6848	6771	6695	6621	6548	6476	·7004	6923	6843	6765	6688	6612	6538	6465	6393	37
38	·7086	7005	6925	6847	6770	6694	6620	6547	6475	·7002	6921	6841	6763	6686	6610	6536	6463	6391	38
39	·7085	7004	6924	6846	6769	6693	6619	6546	6474	·7001	6920	6840	6762	6685	6609	6535	6462	6390	39
40	·7083	7002	6922	6844	6767	6691	6617	6544	6472	·6999	6918	6838	6760	6683	6607	6533	6460	6388	40
41	·7082	7001	6921	6843	6766	6690	6616	6543	6471	·6998	6917	6837	6759	6682	6606	6532	6459	6387	41
42	·7080	7000	6920	6842	6765	6689	6615	6542	6470	·6997	6916	6836	6758	6681	6605	6531	6458	6386	42
43	·7079	6998	6918	6840	6763	6687	6613	6540	6468	·6995	6914	6834	6756	6679	6603	6529	6456	6384	43
44	·7077	6996	6916	6838	6761	6685	6611	6538	6466	·6994	6913	6833	6755	6678	6602	6528	6455	6383	44
45	·7076	6995	6915	6837	6760	6684	6610	6537	6465	·6993	6912	6832	6754	6677	6601	6527	6454	6382	45
46	·7075	6994	6914	6836	6759	6683	6609	6536	6464	·6991	6911	6831	6753	6676	6600	6526	6453	6381	46
47	·7073	6992	6912	6834	6757	6681	6607	6534	6462	·6990	6909	6829	6751	6674	6598	6524	6451	6379	47
48	·7072	6991	6911	6833	6756	6680	6606	6533	6461	·6988	6907	6827	6749	6672	6596	6522	6449	6377	48
49	·7070	6989	6909	6831	6754	6678	6604	6531	6459	·6987	6906	6826	6748	6671	6595	6521	6448	6376	49
50	·7069	6988	6908	6830	6753	6677	6603	6530	6458	·6986	6905	6825	6747	6670	6594	6520	6447	6375	50
51	·7068	6987	6907	6829	6752	6676	6602	6529	6457	·6984	6903	6823	6745	6668	6592	6518	6445	6373	51
52	·7066	6985	6905	6827	6750	6674	6600	6527	6455	·6983	6902	6822	6744	6667	6591	6517	6444	6372	52
53	·7065	6984	6904	6826	6749	6673	6599	6526	6454	·6982	6901	6821	6743	6666	6590	6516	6443	6371	53
54	·7063	6982	6902	6824	6747	6671	6597	6524	6452	·6980	6899	6819	6741	6664	6588	6514	6441	6369	54
55	·7062	6981	6901	6823	6746	6670	6596	6523	6451	·6979	6898	6818	6740	6663	6587	6513	6440	6368	55
56	·7061	6980	6900	6822	6745	6669	6595	6522	6450	·6978	6897	6817	6739	6662	6586	6512	6439	6367	56
57	·7059	6978	6898	6820	6743	6667	6593	6520	6448	·6976	6895	6815	6737	6660	6584	6510	6437	6365	57
58	·7058	6977	6897	6819	6742	6666	6592	6519	6447	·6975	6894	6814	6736	6659	6583	6509	6436	6364	58
59	·7056	6975	6895	6817	6740	6664	6590	6517	6445	·6974	6893	6813	6735	6658	6582	6508	6435	6363	59
	53′	54′	55′	56′	57′	58′	59′	60′	61′	53′	54′	55′	56′	57′	58′	59′	60′	61′	

TABLE 34

Logarithms of the Apparent Altitudes and Horizontal Parallax.

Apparent Altitude 43°									Apparent Altitude 44°									′ or ″	P.P. to ″ of Par.
Moon's Horizontal Parallax.									Moon's Horizontal Parallax.										
53′	54′	55′	56′	57′	58′	59′	60′	61′	53′	54′	55′	56′	57′	58′	59′	60′	61′		
0·6972	6891	6811	6733	6656	6580	6506	6433	6361	0 6892	6811	6731	6653	6576	6500	6426	6353	6281	0	−0
·6971	6890	6810	6732	6655	6579	6505	6432	6360	·6891	6810	6730	6652	6575	6499	6425	6352	6280	1	1
·6969	6888	6808	6730	6653	6577	6503	6430	6358	·6890	6809	6729	6651	6574	6498	6424	6351	6279	2	3
·6968	6887	6807	6729	6652	6576	6502	6429	6357	·6888	6807	6727	6649	6572	6496	6422	6349	6277	3	4
·6967	6886	6806	6728	6651	6575	6501	6428	6356	·6887	6806	6726	6648	6571	6495	6421	6348	6276	4	5
·6965	6884	6804	6726	6649	6573	6499	6426	6354	·6886	6805	6725	6647	6570	6494	6420	6347	6275	5	6
·6964	6883	6803	6725	6648	6572	6498	6425	6353	·6884	6803	6723	6645	6568	6492	6418	6345	6273	6	8
·6963	6882	6802	6724	6647	6571	6487	6424	6352	·6883	6802	6722	6644	6567	6491	6417	6344	6272	7	9
·6961	6880	6800	6722	6645	6569	6495	6422	6350	·6882	6801	6721	6643	6566	6490	6416	6343	6271	8	10
·6960	6879	6799	6721	6644	6568	6494	6421	6349	·6881	6800	6720	6642	6565	6489	6415	6342	6270	9	11
·6959	6878	6798	6720	6643	6567	6493	6420	6348	·6880	6799	6719	6641	6564	6488	6414	6341	6269	10	13
·6957	6876	6796	6718	6641	6565	6491	6418	6346	·6878	6797	6717	6639	6562	6486	6412	6339	6267	11	14
·6956	6875	6795	6717	6640	6564	6490	6417	6345	·6877	6796	6716	6638	6561	6485	6411	6338	6266	12	15
·6955	6874	6794	6716	6639	6563	6489	6416	6344	·6875	6794	6714	6636	6559	6483	6409	6336	6264	13	17
·6953	6872	6792	6714	6637	6561	6487	6414	6342	·6874	6793	6713	6635	6558	6482	6408	6335	6263	14	18
·6952	6871	6791	6713	6636	6560	6486	6413	6341	·6873	6792	6712	6634	6557	6481	6407	6334	6262	15	19
·6951	6870	6790	6712	6635	6559	6485	6412	6340	·6871	6790	6710	6632	6555	6479	6405	6332	6261	16	20
·6949	6868	6788	6710	6633	6557	6483	6410	6338	·6870	6789	6709	6631	6554	6478	6404	6331	6259	17	22
·6948	6867	6787	6709	6632	6556	6482	6409	6337	·6869	6788	6708	6630	6553	6477	6403	6330	6258	18	23
·6947	6866	6786	6708	6631	6555	6481	6408	6336	·6868	6787	6707	6629	6552	6475	6401	6328	6256	19	24
·6945	6864	6784	6706	6629	6553	6479	6406	6334	·6866	6785	6705	6627	6550	6474	6400	6327	6255	20	25
·6944	6863	6783	6705	6628	6552	6478	6405	6333	·6865	6784	6704	6626	6549	6473	6399	6326	6254	21	27
·6943	6862	6782	6704	6627	6551	6477	6404	6332	·6864	6783	6703	6625	6548	6472	6398	6325	6253	22	28
·6941	6860	6780	6702	6625	6549	6475	6402	6330	·6862	6781	6701	6623	6546	6470	6396	6323	6251	23	29
·6940	6859	6779	6701	6624	6548	6474	6401	6329	·6861	6780	6700	6622	6545	6469	6395	6322	6250	24	30
·6939	6858	6778	6700	6623	6547	6473	6400	6328	·6860	6779	6699	6621	6544	6468	6394	6321	6249	25	32
·6937	6856	6776	6698	6621	6545	6471	6398	6326	·6859	6778	6698	6620	6543	6467	6393	6320	6248	26	33
·6936	6855	6775	6697	6620	6544	6470	6397	6325	·6857	6776	6696	6618	6541	6465	6391	6318	6246	27	34
·6935	6854	6774	6696	6619	6543	6469	6396	6324	·6856	6775	6695	6617	6540	6464	6390	6317	6245	28	35
·6933	6852	6772	6694	6617	6541	6467	6394	6322	·6855	6774	6694	6616	6539	6463	6389	6316	6244	29	37
·6932	6851	6771	6693	6616	6540	6466	6393	6321	·6853	6772	6692	6614	6537	6461	6387	6314	6242	30	38
·6931	6850	6770	6692	6615	6539	6465	6392	6320	·6852	6771	6691	6613	6536	6460	6386	6313	6241	31	39
·6929	6848	6768	6690	6613	6537	6463	6390	6318	·6851	6770	6690	6612	6535	6459	6385	6312	6240	32	41
·6928	6847	6767	6689	6612	6536	6462	6389	6317	·6850	6769	6689	6611	6534	6458	6384	6311	6239	33	42
·6927	6846	6766	6688	6611	6535	6461	6388	6316	·6848	6767	6687	6609	6532	6456	6382	6309	6237	34	43
·6925	6844	6764	6686	6609	6533	6459	6386	6314	·6847	6766	6686	6608	6531	6455	6381	6308	6236	35	44
·6924	6843	6763	6685	6608	6532	6458	6385	6313	·6846	6765	6685	6607	6530	6454	6380	6307	6235	36	45
·6923	6842	6762	6684	6607	6531	6457	6384	6312	·6844	6763	6683	6605	6528	6452	6378	6305	6233	37	47
·6921	6840	6760	6682	6605	6529	6455	6382	6310	·6843	6762	6682	6604	6527	6451	6377	6304	6232	38	48
·6920	6839	6759	6681	6604	6528	6454	6381	6309	·6842	6761	6681	6603	6526	6450	6376	6303	6231	39	49
·6919	6838	6758	6680	6603	6527	6453	6380	6308	·6841	6760	6680	6602	6525	6449	6375	6302	6230	40	51
·6917	6836	6756	6678	6601	6525	6451	6378	6306	·6839	6758	6678	6600	6523	6447	6373	6300	6228	41	52
·6916	6835	6755	6677	6600	6524	6450	6377	6305	·6838	6757	6677	6599	6522	6446	6372	6299	6227	42	53
·6915	6834	6754	6676	6599	6523	6449	6376	6304	·6837	6756	6676	6598	6521	6445	6371	6298	6226	43	54
·6913	6832	6752	6674	6597	6521	6447	6374	6302	·6835	6754	6674	6596	6519	6443	6369	6296	6224	44	56
·9912	6831	6751	6673	6596	6520	6446	6373	6301	·6834	6753	6673	6595	6518	6442	6368	6295	6223	45	57
·6910	6829	6749	6671	6594	6518	6444	6371	6299	·6833	6752	6672	6594	6517	6441	6367	6294	6222	46	58
·6909	6828	6748	6670	6593	6517	6443	6370	6298	·6832	6751	6671	6593	6516	6440	6366	6293	6221	47	59
·6908	6827	6747	6669	6592	6516	6442	6369	6297	·6830	6749	6669	6591	6514	6438	6364	6291	6219	48	61
·6907	6826	6746	6668	6591	6515	6441	6368	6296	·6829	6748	6668	6590	6513	6437	6363	6290	6218	49	62
·6905	6824	6744	6666	6589	6513	6439	6366	6294	·6828	6747	6667	6589	6512	6436	6362	6289	6217	50	63
·6904	6823	6743	6665	6588	6512	6438	6365	6293	·6827	6746	6666	6588	6511	6435	6361	6288	6216	51	64
·6903	6822	6742	6664	6587	6511	6437	6364	6292	·6825	6744	6664	6586	6509	6433	6359	6286	6214	52	66
·6901	6820	6740	6662	6585	6509	6435	6362	6290	·6824	6743	6663	6585	6508	6432	6358	6285	6213	53	67
·6900	6819	6739	6661	6584	6508	6434	6361	6289	·6823	6742	6662	6584	6507	6431	6357	6284	6212	54	68
·6899	6818	6738	6660	6583	6507	6433	6360	6288	·6821	6740	6660	6582	6505	6429	6355	6282	6210	55	69
·6898	6817	6737	6659	6582	6506	6432	6359	6287	·6820	6739	6659	6581	6504	6428	6354	6281	6209	56	71
·6896	6815	6735	6657	6580	6504	6430	6357	6285	·6819	6738	6658	6580	6503	6427	6353	6280	6208	57	72
·6895	6814	6734	6656	6579	6503	6429	6356	6284	·6818	6737	6657	6579	6502	6426	6352	6279	6207	58	73
·6894	6813	6733	6655	6578	6502	6428	6355	6283	·6816	6735	6655	6577	6500	6424	6350	6277	6205	59	74

TABLE 34

Logarithms of the Apparent Altitudes and Horizontal Parallax.

	Apparent Altitude 45°									Apparent Altitude 46°										
	Moon's Horizontal Parallax.									Moon's Horizontal Parallax.									′ or ″	P.P. to ″ of Par.
′	53′	54′	55′	56′	57′	58′	59′	60′	61′	53′	54′	55′	56′	57′	58′	59′	60′	61′		
0	0 ·6815	6734	6654	6576	6499	6423	6349	6276	6204	0 ·6741	6660	6580	6502	6425	6349	6275	6202	6130	0	—
1	·6814	6733	6653	6575	6498	6422	6348	6275	6203	·6739	6658	6578	6500	6423	6347	6273	6200	6128	1	1
2	·6813	6732	6652	6574	6497	6421	6347	6274	6202	·6738	6657	6577	6499	6422	6346	6272	6199	6127	2	3
3	6811	6730	6650	6572	6495	6419	6345	6272	6200	·6737	6656	6576	6498	6421	6345	6271	6198	6126	3	4
4	·6810	6729	6649	6571	6494	6418	6344	6271	6199	·6736	6655	6575	6497	6420	6344	6270	6197	6125	4	5
5	·6809	6728	6648	6570	6493	6417	6343	6270	6198	·6735	6654	6574	6496	6419	6343	6269	6196	6124	5	6
6	·6808	6727	6647	6569	6492	6416	6342	6269	6197	·6733	6652	6572	6194	6417	6341	6267	6194	6122	6	8
7	·6806	6725	6645	6567	6490	6414	6340	6267	6195	·6732	6651	6571	6493	6416	6340	6266	6193	6121	7	9
8	·6805	6724	6644	6566	6489	6413	6339	6266	6194	·6731	6650	6570	6492	6415	6339	6265	6192	6120	8	10
9	·6804	6723	6643	6565	6488	6412	6338	6265	6193	·6730	6649	6569	6491	6414	6338	6264	6191	6119	9	11
10	·6803	6722	6642	6564	6487	6411	6337	6264	6192	·6728	6647	6567	6489	6412	6336	6262	6189	6117	10	13
11	·6801	6721	6641	6563	6486	6410	6336	6263	6191	·6727	6646	6566	6488	6411	6335	6361	6188	6116	11	14
12	·6800	6719	6639	6561	6484	6408	6334	6261	6189	·6726	6645	6565	6487	6410	6334	6260	6187	6115	12	15
13	·6799	6718	6638	6560	6483	6407	6333	6260	6188	·6725	6644	6564	6486	6409	6333	6259	6186	6114	13	17
14	·6798	6717	6637	6559	6482	6406	6332	6259	6187	·6724	6643	6563	6485	6408	6332	6258	6185	6113	14	18
15	·6796	6715	6635	6557	6480	6404	6330	6257	6185	·6722	6641	6561	6483	6406	6330	6256	6183	6111	15	19
16	·6795	6714	6634	6556	6479	6403	6329	6256	6184	·6721	6640	6560	6482	6405	6329	6255	6182	6110	16	20
17	·6794	9713	6633	6555	6478	6402	6328	6255	6183	·6720	6639	6559	6481	6404	6328	6254	6181	6109	17	22
18	·6793	6712	6632	6554	6477	6401	6327	6254	6182	·6719	6638	6558	6480	6403	6327	6253	6180	6108	18	23
19	·6791	6710	6630	6552	6475	6399	6325	6252	6180	·6718	6637	6557	6479	6402	6326	6252	6179	6107	19	24
20	·6790	6709	6629	6551	6474	6398	6324	6251	6179	·6716	6635	6555	6477	6400	6324	6250	6177	6105	20	25
21	·6789	6708	6628	6550	6473	6397	6323	6250	6178	·6715	6634	6554	6476	6399	6323	6249	6176	6104	21	27
22	·6788	6707	6627	6549	6472	6396	6322	6249	6177	·6714	6633	6553	6475	6398	6321	6248	6175	6103	22	28
23	·6786	6705	6625	6547	6470	6394	6320	6247	6175	·6713	6632	6552	6474	6397	6320	6247	6174	6102	23	29
24	·6785	6704	6624	6546	6469	6393	6319	6246	6174	·6712	6631	6551	6473	6396	6319	6246	6173	6101	24	30
25	·6784	6703	6623	6545	6468	6392	6318	6245	6173	·6710	6629	6549	6471	6395	6318	6244	6171	6099	25	32
26	·6783	6702	6622	6544	6467	6391	6317	6244	6172	·6709	6628	6548	6470	6393	6317	6243	6170	6098	26	33
27	·6781	6700	6620	6542	6465	6389	6315	6242	6170	·6708	6627	6547	6469	6392	6316	6242	6169	6097	27	34
28	·6780	6699	6619	6541	6464	6388	6314	6241	6169	·6707	6626	6546	6468	6391	6315	6241	6168	6096	28	35
29	·6779	6698	6618	6540	6463	6387	6313	6240	6168	·6706	6625	6545	6467	6390	6314	6240	6167	6095	29	37
30	·6778	6697	6617	6539	6462	6386	6312	6239	6167	·6704	6623	6543	6465	6389	6313	6239	6166	6094	30	38
31	·6776	6695	6615	6537	6460	6384	6310	6237	6165	·6703	6622	6542	6464	6387	6311	6237	6164	6092	31	39
32	·6775	6694	6614	6536	6459	6383	6309	6236	6164	·6702	6621	6541	6463	6386	6310	6236	6163	6091	32	41
33	·6774	6693	6613	6535	6458	6382	6308	6235	6163	·6701	6620	6540	6462	6385	6309	6235	6162	6090	33	42
34	·6773	6692	6612	6534	6457	6381	6307	6234	6162	·6700	6619	6539	6461	6384	6308	6234	6161	6089	34	43
35	·6771	6690	6610	6532	6455	6379	6305	6232	6160	·6698	6617	6537	6459	6382	6306	6332	6159	6087	35	44
36	·6770	6689	6609	6531	6454	6378	6304	6231	6159	·6697	6616	6536	6458	6381	6305	6231	6158	6086	36	45
37	·6769	6688	6608	6530	6453	6377	6303	6230	6158	·6696	6615	6535	6457	6380	6304	6230	6157	6085	37	47
38	·6768	6687	6607	6529	6452	6376	6302	6229	6157	·6695	6614	6534	6456	6379	6303	6229	6156	6084	38	48
39	·6766	6685	6605	6527	6450	6374	6300	6227	6155	·6694	6613	6533	6455	6378	6302	6228	6155	6083	39	49
40	·6765	6684	6604	6526	6449	6373	6299	6226	6154	·6692	6611	6531	6453	6376	6300	6226	6153	6081	40	51
41	·6764	6683	6603	6525	6448	6372	6298	6225	6153	·6691	6610	6530	6452	6375	6299	6225	6152	6080	41	52
42	·6763	6682	6602	6524	6447	6371	6297	6224	6152	·6690	6609	6529	6451	6374	6298	6224	6151	6079	42	53
43	·6761	6680	6600	6522	6445	6369	6295	6222	6150	·6689	6608	6528	6450	6373	6297	6223	6150	6078	43	54
44	·6760	6679	6599	6521	6444	6368	6294	6221	6149	·6688	6607	6527	6449	6372	6296	6222	6149	6077	44	56
45	·6759	6678	6598	6520	6443	6367	6293	6220	6148	·6686	6605	6525	6447	6370	6294	6220	6147	6075	45	57
46	·6758	6677	6597	6519	6442	6366	6292	6219	6147	·6685	6604	6524	6446	6369	6293	6219	6146	6074	46	58
47	·6757	6676	6596	6518	6441	6365	6291	6218	6146	·6684	6603	6523	6445	6368	6292	6218	6145	6073	47	59
48	·6755	6674	6594	6516	6439	6363	6289	6216	6144	·6683	6602	6522	6444	6367	6291	6217	6144	6072	48	61
49	·6754	6673	6593	6515	6438	6362	6288	6215	6143	·6682	6601	6521	6443	6366	6290	6216	6143	6071	49	62
50	·6753	6672	6592	6514	6437	6361	6287	6214	6142	·6681	6600	6520	6442	6365	6289	6215	6142	6070	50	63
51	·6752	6671	6591	6513	6436	6360	6286	6213	6141	·6680	6599	6519	6441	6364	6288	6214	6141	6069	51	64
52	·6750	6669	6589	6511	6434	6358	6284	6211	6139	·6679	6598	6518	6440	6363	6287	6213	6140	6068	52	66
53	·6749	6668	6588	6510	6433	6357	6283	6210	6138	·6677	6596	6516	6438	6361	6285	6211	6138	6066	53	67
54	·6748	6667	6587	6509	6432	6356	6282	6209	6137	·6676	6595	6515	6437	6360	6284	6210	6137	6065	54	68
55	·6747	6666	6586	6508	6431	6355	6281	6208	6136	·6675	6594	6514	6436	6359	6283	6209	6136	6064	55	69
56	·6746	6665	6585	6507	6430	6354	6280	6207	6139	·6673	6592	6512	6434	6357	6281	6207	6134	6062	56	71
57	·6744	6663	6583	6505	6428	6352	6278	6205	6133	·6672	6591	6511	6433	6356	6280	6206	6133	6061	57	72
58	·6743	6662	6582	6504	6427	6351	6277	6204	6132	·6671	6590	6510	6432	6355	6279	6205	6132	6060	58	73
59	·6742	6661	6581	6503	6426	6350	6276	6203	6131	·6670	6589	6509	6431	6354	6278	6204	6131	6059	59	74
	53′	54′	55′	56′	57′	58′	59′	60′	61′	53′	54′	55′	56′	57′	58′	59′	60′	61′		

Logarithms of the Apparent Altitudes and Horizontal Parallax.

Apparent Altitude 47°									Apparent Altitude 48°									′ or ″	P.P. to ″ of Par.
Moon's Horizontal Parallax.									Moon's Horizontal Parallax.										
53′	54′	55′	56′	57′	58′	59′	60′	61′	53′	54′	55′	56′	57′	58′	59′	60′	61′		
0·6669	6588	6508	6430	6353	6277	6203	6130	6058	0.6599	6518	6438	6360	6283	6207	6134	6061	5989	0	0
·6668	6587	6507	6429	6352	6276	6202	6129	6057	·6598	6517	6437	6359	6282	6206	6133	6060	5988	1	1
·6667	6586	6506	6428	6351	6275	6201	6128	6056	·6597	6516	6436	6358	6281	6205	6132	6059	5987	2	3
·6666	6585	6505	6427	6350	6274	6200	6127	6055	·6596	6515	6435	6357	6280	6204	6131	6058	5986	3	4
·6665	6584	6504	6426	6349	6273	6199	6126	6054	·6595	6514	6434	6356	6279	6203	6130	6057	5985	4	5
·6664	6583	6503	6425	6348	6272	6198	6125	6053	·6594	6513	6433	6355	6278	6202	6129	6056	5983	5	6
·6662	6581	6501	6423	6346	6270	6196	6123	6051	·6592	6511	6431	6353	6276	6200	6127	6055	5982	6	8
·6661	6580	6500	6422	6345	6269	6195	6122	6050	·6591	6510	6430	6352	6275	6199	6126	6053	5981	7	9
·6660	6579	6499	6421	6344	6268	6194	6121	6049	·6590	6509	6429	6351	6274	6198	6125	6052	5980	8	10
·6658	6577	6497	6419	6342	6266	6192	6119	6047	·6589	6508	6428	6350	6273	6197	6124	6051	5979	9	11
·6657	6576	6496	6418	6341	6265	6191	6118	6046	·6588	6507	6427	6349	6272	6196	6123	6050	5978	10	13
·6656	6575	6495	6417	6340	6264	6190	6117	6045	·6587	6506	6426	6348	6271	6195	6122	6049	5977	11	14
·6655	6574	6494	6416	6339	6263	6189	6116	6044	·6586	6505	6425	6347	6270	6194	6121	6048	5976	12	15
·6653	6572	6492	6414	6337	6261	6187	6114	6042	·6585	6504	6424	6346	6269	6193	6120	6047	5975	13	17
·6652	6571	6491	6413	6336	6260	6186	6113	6041	·6583	6502	6422	6344	6267	6191	6118	6045	5973	14	18
·6651	6570	6490	6412	6335	6259	6185	6112	6040	·6582	6501	6421	6343	6266	6190	6117	6044	5972	15	19
·6650	6569	6489	6411	6334	6258	6184	6111	6039	·6581	6500	6420	6342	6265	6189	6116	6043	5971	16	20
·6649	6568	6488	6410	6333	6257	6183	6110	6038	·6580	6499	6419	6341	6264	6188	6115	6042	5970	17	22
·6648	6567	6487	6409	6332	6256	6182	6109	6037	·6579	6498	6418	6340	6263	6187	6114	6041	5969	18	23
·6646	6565	6485	6407	6330	6254	6180	6107	6035	·6578	6497	6417	6339	6262	6186	6113	6040	5968	19	24
·6645	6564	6484	6406	6329	6253	6179	6106	6034	·6577	6496	6416	6338	6261	6185	6112	6039	5967	20	25
·6644	6563	6483	6405	6328	6252	6178	6105	6033	·6576	6495	6415	6337	6260	6184	6111	6038	5966	21	27
·6643	6562	6482	6404	6327	6251	6177	6104	6032	·6574	6493	6413	6335	6258	6182	6109	6036	5964	22	28
·6642	6561	6481	6403	6326	6250	6176	6103	6031	·6573	6492	6412	6334	6257	6181	6107	6034	5962	23	29
·6641	6560	6480	6402	6325	6249	6175	6102	6030	·6572	6491	6411	6333	6256	6180	6106	6033	5961	24	30
·6639	6558	6478	6400	6323	6247	6173	6100	6028	·6571	6490	6410	6332	6255	6179	6105	6032	5960	25	32
·6638	6557	6477	6399	6322	6246	6172	6099	6027	·6570	6489	6409	6331	6254	6178	6104	6031	5959	26	33
·6637	6556	6476	6398	6321	6245	6171	6098	6026	·6569	6488	6408	6330	6253	6177	6103	6030	5958	27	34
·6636	6555	6475	6397	6320	6244	6170	6097	6025	·6568	6487	6407	6329	6252	6176	6102	6029	5957	28	35
·6635	6554	6474	6396	6319	6243	6169	6096	6024	·6567	6486	6406	6328	6251	6175	6101	6028	5956	29	37
·6634	6553	6473	6395	6318	6242	6168	6095	6023	·6565	6484	6404	6326	6249	6173	6099	6026	5954	30	38
·6633	6552	6472	6394	6317	6241	6167	6094	6022	·6564	6483	6403	6325	6248	6172	6098	6025	5953	31	39
·6631	6550	6470	6392	6315	6239	6165	6092	6020	·6563	6482	6402	6324	6247	6171	6097	6024	5952	32	41
·6630	6549	6469	6391	6314	6238	6164	6091	6019	·6562	6481	6401	6323	6246	6170	6096	6023	5951	33	42
·6629	6548	6468	6390	6313	6237	6163	6090	6018	·6561	6480	6400	6322	6245	6169	6095	6022	5950	34	43
·6628	6547	6467	6389	6312	6236	6162	6089	6017	·6560	6479	6399	6321	6244	6168	6094	6021	5949	35	44
·6627	6546	6466	6388	6311	6235	6161	6088	6016	·6559	6478	6398	6320	6243	6167	6093	6020	5948	36	45
·6626	6545	6465	6387	6310	6234	6160	6087	6015	·6558	6477	6397	6319	6242	6166	6092	6019	5947	37	47
·6624	6543	6463	6385	6308	6232	6158	6085	6013	·6557	6476	6396	6318	6241	6165	6091	6018	5946	38	48
·6623	6542	6462	6384	6307	6231	6157	6084	6012	·6555	6474	6394	6316	6239	6163	6089	6016	5944	39	49
·6622	6541	6461	6383	6306	6230	6156	6083	6011	·6554	6473	6393	6315	6238	6162	6088	6015	5943	40	51
·6621	6540	6460	6382	6305	6229	6155	6082	6010	·6553	6472	6392	6314	6237	6161	6087	6014	5942	41	52
·6620	6539	6459	6381	6304	6228	6154	6081	6009	·6552	6471	6391	6313	6236	6160	6086	6013	5941	42	53
·6619	6538	6458	6380	6303	6227	6153	6080	6008	·6551	6470	6390	6312	6235	6159	6085	6012	5940	43	54
·6618	6537	6457	6379	6302	6226	6152	6079	6007	·6550	6469	6389	6311	6234	6158	6084	6011	5939	44	56
·6616	6535	6455	6377	6300	6224	6150	6077	6005	·6549	6468	6388	6310	6233	6157	6083	6010	5938	45	57
·6615	6534	6454	6376	6299	6223	6149	6076	6004	·6548	6467	6387	6309	6232	6156	6082	6009	5937	46	58
·6614	6533	6453	6375	6298	6222	6148	6075	6003	·6547	6466	6386	6308	6231	6155	6081	6008	5936	47	59
·6613	6532	6452	6374	6297	6221	6147	6074	6002	·6545	6464	6384	6306	6229	6153	6079	6006	5934	48	61
·6612	6531	6451	6373	6296	6220	6146	6073	6001	·6544	6463	6383	6305	6228	6152	6078	6005	5933	49	62
·6611	6530	6450	6372	6295	6219	6145	6072	6000	·6543	6462	6382	6304	6227	6151	6077	6004	5932	50	63
·6610	6529	6449	6371	6294	6218	6144	6071	5999	·6542	6461	6381	6303	6226	6150	6076	6003	5931	51	64
·6608	6527	6447	6369	6292	6216	6142	6069	5997	·6541	6460	6380	6302	6225	6149	6075	6002	5930	52	66
·6607	6526	6446	6368	6291	6215	6141	6068	5996	·6540	6459	6379	6301	6224	6148	6074	6001	5929	53	67
·6606	6525	6445	6367	6290	6214	6140	6067	5995	·6539	6458	6378	6300	6223	6147	6073	6000	5928	54	68
·6605	6524	6444	6366	6289	6213	6139	6066	5994	·6538	6457	6377	6299	6222	6146	6072	5999	5927	55	69
·6604	6523	6443	6365	6288	6212	6138	6065	5993	·6537	6456	6376	6298	6221	6145	6071	5998	5926	56	71
·6603	6522	6442	6364	6287	6211	6137	6064	5992	·6535	6454	6374	6296	6219	6143	6069	5996	5924	57	72
·6602	6521	6441	6363	6286	6210	6136	6063	5991	·6534	6453	6373	6295	6218	6142	6068	5995	5923	58	73
·6600	6519	6439	6361	6284	6208	6135	6062	5990	·6533	6452	6372	6294	6217	6141	6067	5994	5922	59	74
53′	54′	55′	56′	57′	58′	59′	60′	61′	53′	54′	55′	56′	57′	58′	59′	60′	61′		

TABLE 34

Logarithms of the Apparent Altitudes and Horizontal Parallax.

	Apparent Altitude 49°									Apparent Altitude 50°										
	Moon's Horizontal Parallax.									Moon's Horizontal Parallax.										P. ts of Par
′	53′	54′	55′	56′	57′	58′	59′	60′	61′	53′	54′	55′	56′	57′	58′	59′	60′	61′	′ or ″	
0	0·6532	6451	6371	6293	6216	6140	6066	5993	5921	0·6467	6386	6306	6228	6151	6075	6001	5928	5856	0	—0
1	·6531	6450	6370	6292	6215	6139	6065	5992	5920	·6466	6385	6305	6227	6150	6074	6000	5927	5855	1	1
2	·6530	6449	6369	6291	6214	6138	6064	5991	5919	·6465	6384	6304	6226	6149	6073	5999	5926	5854	2	3
3	·6529	6448	6368	6290	6213	6137	6063	5990	5918	·6464	6383	6303	6225	6148	6072	5998	5925	5853	3	4
4	·6528	6447	6367	6288	6211	6135	6061	5988	5916	·6463	6382	6302	6224	6147	6071	5997	5924	5852	4	5
5	·6527	6446	6365	6287	6210	6134	6060	5987	5915	·6462	6381	6301	6223	6146	6070	5996	5923	5851	5	6
6	·6526	6445	6364	6286	6209	6133	6059	5986	5914	·6461	6380	6300	6222	6145	6069	5995	5922	5850	6	8
7	·6525	6444	6363	6285	6208	6132	6058	5985	5913	·6460	6879	6299	6221	6144	6068	5994	5921	5849	7	9
8	·6523	6442	6362	6284	6207	6131	6057	5984	5912	·6459	6378	6298	6220	6143	6067	5993	5920	5848	8	10
9	·6522	6441	6361	6283	6206	6130	6056	5983	5911	·6458	6377	6297	6219	6142	6066	5992	5919	5847	9	11
10	·6521	6440	6360	6282	6205	6129	6055	5982	5910	·6457	6376	6296	6218	6141	6065	5991	5918	5846	10	13
11	·6520	6439	6359	6281	6204	6128	6054	5981	5909	·6456	6375	6295	6217	6140	6064	5990	5917	5845	11	14
12	·6519	6438	6358	6280	6203	6127	6053	5980	5908	·6455	6374	6294	6216	6139	6063	5989	5916	5844	12	15
13	·6518	6437	6357	6279	6202	6126	6052	5979	5907	·6454	6373	6293	6215	6138	6062	5988	5915	5843	13	17
14	·6517	6436	6356	6278	6201	6125	6051	5978	5906	·6453	6372	6292	6214	6137	6061	5987	5914	5842	14	18
15	·6516	6435	6355	6277	6200	6124	6050	5977	5905	·6452	6371	6291	6213	6136	6060	5986	5913	5841	15	19
16	·6515	6434	6354	6276	6199	6123	6049	5976	5904	·6451	6370	6290	6212	6135	6059	5985	5912	5840	16	20
17	·6514	6433	6353	6275	6198	6122	6048	5975	5903	·6450	6369	6289	6211	6134	6058	5984	5911	5839	17	22
18	·6513	6432	6352	6274	6197	6121	6047	5974	5902	·6448	6367	6287	6209	6132	6056	5982	5909	5837	18	23
19	·6511	6430	6350	6272	6195	6119	6045	5972	5900	·6447	6366	6286	6208	6131	6055	5981	5908	5836	19	24
20	·6510	6429	6349	6271	6194	6118	6044	5971	5899	·6446	6365	6285	6207	6130	6054	5980	5907	5835	20	25
21	·6509	6428	6348	6270	6193	6117	6043	5970	5898	·6445	6364	6284	6206	6129	6053	5979	5906	5834	21	27
22	·6508	6427	6347	6269	6192	6116	6042	5969	5897	·6444	6363	6283	6205	6128	6052	5978	5905	5833	22	28
23	·6507	6426	6346	6268	6191	6115	6041	5968	5896	·6443	6362	6282	6204	6127	6051	5977	5904	5832	23	29
24	·6506	6425	6345	6267	6190	6114	6040	5967	5895	·6442	6361	6281	6203	6126	6050	5976	5903	5831	24	30
25	·6505	6424	6344	6266	6189	6113	6039	5966	5894	·6441	6360	6280	6202	6125	6049	5975	5902	5830	25	32
26	·6504	6423	6343	6265	6188	6112	6038	5965	5893	·6440	6359	6279	6201	6124	6048	5974	5901	5829	26	33
27	·6503	6422	6342	6264	6187	6111	6037	5964	5892	·6439	6358	6278	6200	6123	6047	5973	5900	5828	27	34
28	·6502	6421	6341	6263	6186	6110	6036	5963	5891	·6438	6357	6277	6199	6122	6046	5972	5899	5827	28	35
29	·6501	6420	6340	6262	6185	6109	6035	5962	5890	·6437	6356	6276	6198	6121	6045	5971	5898	5826	29	37
30	·6500	6419	6339	6261	6184	6108	6034	5961	5889	·6436	6355	6275	6197	6120	6044	5970	5897	5825	30	38
31	·6498	6417	6337	6259	6182	6106	6032	5959	5887	·6435	6354	6274	6196	6119	6043	5969	5896	5824	31	39
32	·6497	6416	6336	6258	6181	6105	6031	5958	5886	·6434	6353	6273	6195	6118	6042	5968	5895	5823	32	41
33	·6496	6415	6335	6257	6180	6104	6030	5957	5885	·6433	6352	6272	6194	6117	6041	5967	5894	5822	33	42
34	·6495	6414	6334	6256	6179	6103	6029	5956	5884	·6432	6351	6271	6193	6116	6040	5966	5893	5821	34	43
35	·6494	6413	6333	6255	6178	6102	6028	5955	5883	·6431	6350	6270	6192	6115	6039	5965	5892	5820	35	44
36	·6493	6412	6332	6254	6177	6101	6027	5954	5882	·6430	6349	6269	6191	6114	6038	5964	5891	5819	36	45
37	·6492	6411	6331	6253	6176	6100	6026	5953	5881	·6429	6348	6268	6190	6113	6037	5963	5890	5818	37	47
38	·6491	6410	6330	6252	6175	6099	6025	5952	5880	·6428	6347	6267	6189	6112	6036	5962	5889	5817	38	48
39	·6490	6409	6329	6251	6174	6098	6024	5951	5879	·6427	6346	6266	6188	6111	6035	5961	5888	5816	39	49
40	·6489	6408	6328	6250	6173	6097	6023	5950	5878	·6426	6345	6265	6187	6110	6034	5960	5887	5815	40	51
41	·6488	6407	6327	6249	6172	6096	6022	5949	5877	·6425	6344	6264	6186	6109	6033	5959	5886	5814	41	52
42	·6487	6406	6326	6248	6171	6095	6021	5948	5876	·6423	6342	6262	6184	6107	6031	5957	5884	5812	42	53
43	·6486	6405	6325	6247	6170	6094	6020	5947	5875	·6422	6341	6261	6183	6106	6030	5956	5883	5811	43	54
44	·6484	6403	6323	6245	6168	6092	6018	5945	5873	·6421	6340	6260	6182	6105	6029	5955	5882	5810	44	56
45	·6483	6402	6322	6244	6167	6091	6017	5944	5872	·6420	6339	6259	6181	6104	6028	5954	5881	5809	45	57
46	·6482	6401	6321	6243	6166	6090	6016	5943	5871	·6419	6338	6258	6180	6103	6027	5953	5880	5808	46	58
47	·6481	6400	6320	6242	6165	6089	6015	5942	5870	·6418	6337	6257	6179	6102	6026	5952	5879	5807	47	59
48	·6480	6399	6319	6241	6164	6088	6014	5941	5869	·6417	6336	6256	6178	6101	6025	5951	5878	5806	48	61
49	·6479	6398	6318	6240	6163	6087	6013	5940	5868	·6416	6335	6255	6177	6100	6024	5950	5877	5805	49	62
50	·6478	6397	6317	6239	6162	6086	6012	5939	5867	·6415	6334	6254	6176	6099	6023	5949	5876	5804	50	63
51	·6477	6396	6316	6238	6161	6085	6011	5938	5866	·6414	6333	6253	6175	6098	6022	5948	5875	5803	51	64
52	·6476	6395	6315	6237	6160	6084	6010	5937	5865	·6413	6332	6252	6174	6097	6021	5947	5874	5802	52	66
53	·6475	6394	6314	6236	6159	6083	6009	5936	5864	·6412	6331	6251	6173	6096	6020	5946	5873	5801	53	67
54	·6474	6393	6313	6235	6158	6082	6008	5935	5863	.6411	6330	6250	6172	6095	6019	5945	5872	5800	54	68
55	·6473	6392	6312	6234	6157	6081	6007	5934	5862	·6410	6329	6249	6171	6094	6018	5944	5871	5799	55	69
56	·6472	6391	6311	6233	6156	6080	6006	5933	5861	·6409	6328	6248	6170	6093	6017	5943	5870	5798	56	71
57	·6471	6390	6310	6232	6155	6079	6005	5932	5860	·6408	6327	6247	6169	6092	6016	5942	5869	5797	57	72
58	·6470	6389	6309	6231	6154	6078	6004	5931	5859	·6407	6326	6246	6168	6091	6015	5941	5868	5796	58	73
59	·6469	6388	6308	6230	6153	6077	6003	5930	5858	·6406	6325	6245	6167	6090	6014	5940	5867	5795	59	74
	53′	54′	55′	56′	57′	58′	59′	60′	61′	53′	54′	55′	56′	57′	58′	59′	60′	61′		

Logarithms of the Apparent Altitudes and Horizontal Parallax.

Apparent Altitude 51°									Apparent Altitude 52°									′ or ″	P.P. to ″ of Par.
Moon's Horizontal Parallax.									Moon's Horizontal Parallax.										
53′	54′	55′	56′	57′	58′	59′	60′	61′	53′	54′	55′	56′	57′	58′	59′	60′	61		
0·6405	6324	6244	6166	6089	6013	5939	5866	5794	0 ·6345	6264	6184	6106	6029	5953	5879	5806	5734	0	—0
·6404	6323	6243	6165	6088	6012	5938	5865	5793	·6344	6263	6183	6105	6028	5952	5878	5805	5733	1	1
·6403	6322	6242	6164	6087	6011	5937	5864	5792	·6343	6262	6182	6104	6027	5951	5877	5804	5732	2	3
·6402	6321	6241	6163	6086	6010	5936	5863	5791	·6342	6261	6181	6103	6026	5950	5876	5803	5731	3	4
·6401	6320	6240	6162	6085	6009	5935	5862	5790	·6341	6260	6180	6102	6025	5949	5875	5802	5730	4	5
·6400	6319	6239	6161	6084	6008	5934	5861	5789	·6340	6259	6179	6101	6024	5948	5874	5801	5729	5	6
·6399	6318	6238	6160	6083	6007	5933	5860	5788	·6339	6258	6178	6100	6023	5947	5873	5800	5728	6	8
·6398	6317	6237	6159	6082	6006	5932	5859	5787	·6338	6257	6177	6099	6022	5946	5872	5799	5727	7	9
·6397	6316	6236	6158	6081	6005	5931	5858	5786	·6337	6256	6176	6098	6021	5945	5871	5798	5726	8	10
·6396	6315	6235	6157	6080	6004	5930	5857	5785	·6336	6255	6175	6097	6020	5944	5870	5797	5725	9	11
·6395	6314	6234	6156	6079	6003	5929	5856	5784	·6335	6254	6174	6096	6019	5943	5869	5796	5724	10	13
·6394	6313	6233	6155	6078	6002	5928	5855	5783	·6334	6253	6173	6095	6018	5942	5868	5795	5723	11	14
·6393	6312	6232	6154	6077	6001	5927	5854	5782	·6333	6252	6172	6094	6017	5941	5867	5794	5722	12	15
·6392	6311	6231	6153	6076	6000	5926	5853	5781	·6332	6251	6171	6093	6016	5940	5866	5793	5721	13	17
·6391	6310	6230	6152	6075	5999	5925	5852	5780	·6331	6250	6170	6092	6015	5939	5865	5792	5720	14	18
·6390	6309	6229	6151	6074	5998	5924	5851	5779	·6330	6249	6169	6091	6014	5938	5864	5791	5719	15	19
·6389	6308	6228	6150	6073	5997	5923	5850	5778	·6329	6248	6168	6090	6013	5937	5863	5790	5718	16	20
·6388	6307	6227	6149	6072	5996	5922	5849	5777	·6328	6247	6167	6089	6012	5936	5862	5789	5717	17	22
·6387	6306	6226	6148	6071	5995	5921	5848	5776	·6327	6246	6166	6088	6011	5935	5861	5788	5716	18	23
·6386	6305	6225	6147	6070	5994	5920	5847	5775	·6326	6245	6165	6087	6010	5934	5860	5787	5715	19	24
·6385	6304	6224	6146	6069	5993	5919	5846	5774	·6325	6244	6164	6086	6009	5933	5859	5786	5714	20	25
·6384	6303	6223	6145	6068	5992	5918	5845	5773	·6324	6243	6163	6085	6008	5932	5858	5785	5713	21	27
·6383	6302	6222	6144	6067	5991	5917	5844	5772	·6323	6242	6162	6084	6007	5931	5857	5784	5712	22	28
·6382	6301	6221	6143	6066	5990	5916	5843	5771	·6322	6241	6161	6083	6006	5930	5856	5783	5711	23	29
·6381	6300	6220	6142	6065	5989	5915	5842	5770	·6321	6240	6160	6082	6005	5929	5855	5782	5710	24	30
·6380	6299	6219	6141	6064	5988	5914	5841	5769	·6320	6239	6159	6081	6004	5928	5854	5781	5709	25	32
·6379	6298	6218	6140	6063	5987	5913	5840	5768	·6319	6238	6158	6080	6003	5927	5853	5780	5708	26	33
·6378	6297	6217	6139	6062	5986	5912	5839	5767	·6318	6237	6157	6079	6002	5926	5852	5779	5707	27	34
·6377	6296	6216	6138	6061	5985	5911	5838	5766	·6317	6236	6156	6078	6001	5925	5851	5778	5706	28	35
·6376	6295	6215	6137	6060	5984	5910	5837	5765	·6316	6235	6155	6077	6000	5924	5850	5777	5705	29	37
·6375	6294	6214	6136	6059	5983	5909	5836	5764	·6315	6234	6154	6076	5999	5923	5849	5776	5704	30	38
·6374	6293	6213	6135	6058	5982	5908	5835	5763	·6314	6233	6153	6075	5998	5922	5848	5775	5703	31	39
·6373	6292	6212	6134	6057	5981	5907	5834	5762	·6313	6232	6152	6074	5997	5921	5847	5774	5702	32	41
·6372	6291	6211	6133	6056	5980	5906	5833	5761	·6312	6231	6151	6073	5996	5920	5846	5773	5701	33	42
·6371	6290	6210	6132	6055	5979	5905	5832	5760	·6311	6230	6150	6072	5995	5919	5845	5772	5700	34	43
·6370	6289	6209	6131	6054	5978	5904	5831	5759	·6310	6229	6149	6071	5994	5918	5844	5771	5699	35	44
·6369	6288	6208	6130	6053	5977	5903	5830	5758	·6310	6229	6149	6071	5994	5918	5844	5771	5699	36	45
·6368	6287	6207	6129	6052	5976	5902	5829	5757	·6309	6228	6148	6070	5993	5917	5843	5770	5698	37	47
·6367	6286	6206	6128	6051	5975	5901	5828	5756	·6308	6227	6147	6069	5992	5916	5842	5769	5697	38	48
·6366	6285	6205	6127	6050	5974	5900	5827	5755	·6307	6226	6146	6068	5991	5915	5841	5768	5696	39	49
·6365	6284	6204	6126	6049	5973	5899	5826	5754	·6306	6225	6145	6067	5990	5914	5840	5767	5695	40	51
·6364	6283	6203	6125	6048	5972	5898	5825	5753	·6305	6224	6144	6066	5989	5913	5839	5766	5694	41	52
·6363	6282	6202	6124	6047	5971	5897	5824	5752	·6304	6223	6143	6065	5988	5912	5838	5765	5693	42	53
·6362	6281	6201	6123	6046	5970	5896	5823	5751	·6303	6222	6142	6064	5987	5911	5837	5764	5692	43	54
·6361	6280	6200	6122	6045	5969	5895	5822	5750	·6302	6221	6141	6063	5986	5910	5836	5763	5691	44	56
·6360	6279	6199	6121	6044	5968	5894	5821	5749	·6301	6220	6140	6062	5985	5909	5835	5762	5690	45	57
·6359	6278	6198	6120	6043	5967	5893	5820	5748	·6300	6219	6139	6061	5984	5908	5834	5761	5689	46	58
·6358	6277	6197	6119	6042	5966	5892	5819	5747	·6299	6218	6138	6060	5983	5907	5833	5760	5688	47	59
·6357	6276	6196	6118	6041	5965	5891	5818	5746	·6298	6217	6137	6059	5982	5906	5832	5759	5687	48	61
·6356	6275	6195	6117	6040	5964	5890	5817	5745	·6297	6216	6136	6058	5981	5905	5831	5758	5686	49	62
·6355	6274	6194	6116	6039	5963	5889	5816	5744	·6296	6215	6135	6057	5980	5904	5830	5757	5685	50	63
·6354	6273	6193	6115	6038	5962	5888	5815	5743	·6295	6214	6134	6056	5979	5903	5829	5756	5684	51	64
·6353	6272	6192	6114	6037	5961	5887	5814	5742	·6294	6213	6133	6055	5978	5902	5828	5755	5683	52	66
·6352	6271	6191	6113	6036	5960	5886	5813	5741	·6293	6212	6132	6054	5977	5901	5827	5754	5682	53	67
·6351	6270	6190	6112	6035	5959	5885	5812	5740	·6292	6211	6131	6053	5976	5900	5826	5753	5681	54	68
·6350	6269	6189	6111	6034	5958	5884	5811	5739	·6291	6210	6130	6052	5975	5899	5825	5752	5680	55	69
·6349	6268	6188	6110	6033	5957	5883	5810	5738	·6290	6209	6129	6051	5974	5898	5824	5751	5679	56	71
·6348	6267	6187	6109	6032	5956	5882	5809	5737	·6289	6208	6128	6050	5973	5897	5823	5750	5678	57	72
·6347	6266	6186	6108	6031	5955	5881	5808	5736	·6288	6207	6127	6049	5972	5896	5822	5749	5677	58	73
·6346	6265	6185	6107	6030	5954	5880	5807	5735	·6287	6206	6126	6048	5971	5895	5821	5748	5676	59	74
53′	54′	55′	56′	57′	58′	59′	60′	61′	53′	54′	55′	56′	57′	58′	59′	60′	61′		

TABLE 34

Logarithms of the Apparent Altitudes and Horizontal Parallax.

	Apparent Altitude 53° — Moon's Horizontal Parallax.									Apparent Altitude 54° — Moon's Horizontal Parallax.										P.P. to ″ of Par.
′	53′	54′	55′	56′	57′	58′	59′	60′	61′	53′	54′	55′	56′	57′	58′	59′	60′	61′	″ or ′	
0	0·6287	6206	6126	6048	5971	5895	5821	5748	5676	0·6230	6149	6069	5991	5914	5838	5764	5691	5619	0	—0
1	·6286	6205	6125	6047	5970	5894	5820	5747	5675	·6230	6149	6069	5991	5914	5838	5764	5691	5619	1	1
2	·6285	6204	6124	6046	5969	5893	5819	5746	5674	·6229	6148	6068	5990	5913	5837	5763	5690	5618	2	3
3	·6284	6203	6123	6045	5968	5892	5818	5745	5673	·6228	6147	6067	5989	5912	5836	5762	5689	5617	3	4
4	·6283	6202	6122	6044	5967	5891	5817	5744	5672	·6227	6146	6066	5988	5911	5835	5761	5688	5616	4	5
5	·6282	6201	6121	6043	5966	5890	5816	5743	5671	·6226	6145	6065	5987	5910	5834	5760	5687	5615	5	6
6	·6281	6200	6120	6042	5965	5889	5815	5742	5670	·6225	6144	6064	5986	5909	5833	5759	5686	5614	6	8
7	·6280	6199	6119	6041	5964	5888	5814	5741	5669	·6224	6143	6063	5985	5908	5832	5758	5685	5613	7	9
8	·6279	6198	6118	6040	5963	5887	5813	5740	5668	·6223	6142	6062	5984	5907	5831	5757	5684	5612	8	10
9	·6278	6197	6117	6039	5962	5886	5812	5739	5667	·6222	6141	6061	5983	5906	5830	5756	5683	5611	9	11
10	·6277	6196	6116	6038	5961	5885	5811	5738	5666	·6221	6140	6060	5982	5905	5829	5755	5682	5610	10	13
11	·6276	6195	6115	6037	5960	5884	5810	5737	5665	·6220	6139	6059	5981	5904	5828	5754	5681	5609	11	14
12	·6275	6194	6114	6036	5959	5883	5809	5736	5664	·6219	6138	6058	5980	5903	5827	5753	5680	5609	12	15
13	·6274	6193	6113	6035	5958	5882	5808	5735	5663	·6219	6138	6058	5980	5903	5827	5753	5680	5608	13	17
14	·6273	6192	6112	6034	5957	5881	5807	5734	5662	·6218	6137	6057	5979	5902	5826	5752	5679	5607	14	18
15	·6272	6191	6111	6033	5956	5880	5806	5733	5661	·6217	6136	6056	5978	5901	5825	5751	5678	5606	15	19
16	·6271	6190	6110	6032	5955	5879	5805	5732	5660	·6216	6135	6055	5977	5900	5824	5750	5677	5605	16	20
17	·6270	6189	6109	6031	5954	5878	5804	5731	5659	·6215	6134	6054	5976	5899	5823	5749	5676	5604	17	22
18	·6269	6188	6108	6030	5953	5877	5803	5730	5658	·6214	6133	6053	5975	5898	5822	5748	5675	5603	18	23
19	·6269	6188	6108	6030	5953	5877	5803	5730	5658	·6213	6132	6052	5974	5897	5821	5747	5674	5602	19	24
20	·6268	6187	6107	6029	5952	5876	5802	5729	5657	·6212	6131	6051	5973	5896	5820	5746	5673	5601	20	25
21	·6267	6186	6106	6028	5951	5875	5801	5728	5656	·6211	6130	6050	5972	5895	5819	5745	5672	5600	21	27
22	·6266	6185	6105	6027	5950	5874	5800	5727	5655	·6210	6129	6049	5971	5894	5818	5744	5671	5599	22	28
23	·6265	6184	6104	6026	5949	5873	5799	5726	5654	·6209	6128	6048	5970	5893	5817	5743	5670	5598	23	29
24	·6264	6183	6103	6025	5948	5872	5798	5725	5653	·6209	6128	6048	5970	5893	5817	5743	5670	5598	24	30
25	·6263	6182	6102	6024	5947	5871	5797	5724	5652	·6208	6127	6047	5969	5892	5816	5742	5669	5597	25	32
26	·6262	6181	6101	6023	5946	5870	5796	5723	5651	·6207	6126	6046	5968	5891	5815	5741	5668	5596	26	33
27	·6261	6180	6100	6022	5945	5869	5795	5722	5650	·6206	6125	6045	5967	5890	5814	5740	5667	5595	27	34
28	·6260	6179	6099	6021	5944	5868	5794	5721	5649	·6205	6124	6044	5966	5889	5813	5739	5666	5594	28	35
29	·6259	6178	6098	6020	5943	5867	5793	5720	5648	·6204	6123	6043	5965	5888	5812	5738	5665	5593	29	37
30	·6258	6177	6097	6019	5942	5866	5792	5719	5647	·6203	6122	6042	5964	5887	5811	5737	5664	5592	30	38
31	·6257	6176	6096	6018	5941	5865	5791	5718	5646	·6202	6121	6041	5963	5886	5810	5736	5663	5591	31	39
32	·6256	6175	6095	6017	5940	5864	5790	5717	5645	·6201	6120	6040	5962	5885	5809	5735	5662	5590	32	41
33	·6255	6174	6094	6016	5939	5863	5789	5716	5644	·6200	6119	6039	5961	5884	5808	5734	5661	5589	33	42
34	·6254	6173	6093	6015	5938	5862	5788	5715	5643	·6200	6119	6039	5961	5884	5808	5734	5661	5589	34	43
35	·6254	6173	6093	6015	5938	5862	5788	5715	5643	·6199	6118	6038	5960	5883	5807	5733	5660	5588	35	44
36	·6253	6172	6092	6014	5937	5861	5787	5714	5642	·6198	6117	6037	5959	5882	5806	5732	5659	5587	36	45
37	·6252	6171	6091	6013	5936	5860	5786	5713	5641	·6197	6116	6036	5958	5881	5805	5731	5658	5586	37	47
38	·6251	6170	6090	6012	5935	5859	5785	5712	5640	·6196	6115	6035	5957	5880	5804	5730	5657	5585	38	48
39	·6250	6169	6089	6011	5934	5858	5784	5711	5639	·6195	6114	6034	5956	5879	5803	5729	5656	5584	39	49
40	·6249	6168	6088	6010	5933	5857	5783	5710	5638	·6194	6113	6033	5955	5878	5802	5728	5655	5583	40	51
41	·6248	6167	6087	6009	5932	5856	5782	5709	5637	·6193	6112	6032	5954	5877	5801	5727	5654	5582	41	52
42	·6247	6166	6086	6008	5931	5855	5781	5708	5636	·6192	6111	6031	5953	5876	5800	5726	5653	5581	42	53
43	·6246	6165	6085	6007	5930	5854	5780	5707	5635	·6191	6110	6030	5952	5875	5799	5725	5652	5580	43	54
44	·6245	6164	6084	6006	5929	5853	5779	5706	5634	·6191	6110	6030	5952	5875	5799	5725	5652	5580	44	56
45	·6244	6163	6083	6005	5928	5852	5778	5705	5633	·6190	6109	6029	5951	5874	5798	5724	5651	5579	45	57
46	·6243	6162	6082	6004	5927	5851	5777	5704	5632	·6189	6108	6028	5950	5873	5797	5723	5650	5578	46	58
47	·6242	6161	6081	6003	5926	5850	5776	5703	5631	·6188	6107	6027	5949	5872	5796	5722	5649	5577	47	59
48	·6241	6160	6080	6002	5925	5849	5775	5702	5630	·6187	6106	6026	5948	5871	5795	5721	5648	5576	48	61
49	·6241	6160	6080	6002	5925	5849	5775	5702	5630	·6186	6105	6025	5947	5870	5794	5720	5647	5575	49	62
50	·6240	6159	6079	6001	5924	5848	5774	5701	5629	·6185	6104	6024	5946	5869	5793	5719	5646	5574	50	63
51	·6239	6158	6078	6000	5923	5847	5773	5700	5628	·6184	6103	6023	5945	5868	5792	5718	5645	5573	51	64
52	·6238	6157	6077	5999	5922	5846	5772	5699	5627	·6183	6102	6022	5944	5867	5791	5717	5644	5572	52	66
53	·6237	6156	6076	5998	5921	5845	5771	5698	5626	·6183	6102	6022	5944	5867	5791	5717	5644	5572	53	67
54	·6236	6155	6075	5997	5920	5844	5770	5697	5625	·6182	6101	6021	5943	5866	5790	5716	5643	5571	54	68
55	·6235	6154	6074	5996	5919	5843	5769	5696	5624	·6181	6100	6020	5942	5865	5789	5715	5642	5570	55	69
56	·6234	6153	6073	5995	5918	5842	5768	5695	5623	·6180	6099	6019	5941	5864	5788	5714	5641	5569	56	71
57	·6233	6152	6072	5994	5917	5841	5767	5694	5622	·6179	6098	6018	5940	5863	5787	5713	5640	5568	57	72
58	·6232	6151	6071	5993	5916	5840	5766	5693	5621	·6178	6097	6017	5939	5862	5786	5712	5639	5567	58	73
59	[illegible]	6150	6070	5992	5915	5839	5765	5692	5620	·6177	6096	6016	5938	5861	5785	5711	5638	5566	59	74

TABLE 34

Logarithms of the Apparent Altitudes and Horizontal Parallax.

Apparent Altitude 55°									Apparent Altitude 56°									' or "	P.P. to " of Par.
Moon's Horizontal Parallax.									Moon's Horizontal Parallax.										
53'	54'	55'	56'	57'	58'	59'	60'	61'	53'	54'	55'	56'	57'	58'	59'	60'	61'		
0 ·6176	6095	6015	5937	5860	5784	5710	5637	5565	0 ·6124	6043	5963	5885	5808	5732	5658	5585	5513	0	0
·6175	6094	6014	5936	5859	5783	5709	5636	5564	·6123	6042	5962	5884	5807	5731	5657	5584	5512	1	1
·6175	6094	6014	5936	5859	5783	5709	5636	5564	·6123	6042	5962	5884	5807	5731	5657	5584	5512	2	3
·6174	6093	6013	5935	5858	5782	5708	5635	5563	·6122	6041	5961	5883	5806	5730	5656	5583	5511	3	4
·6173	6092	6012	5934	5857	5781	5707	5634	5562	·6121	6040	5960	5882	5805	5729	5655	5582	5510	4	5
·6172	6091	6011	5933	5856	5780	5706	5633	5561	·6120	6039	5959	5881	5804	5728	5654	5581	5509	5	6
·6171	6090	6010	5932	5855	5779	5705	5632	5560	·6119	6038	5958	5880	5803	5727	5653	5580	5508	6	8
·6170	6089	6009	5931	5854	5778	5704	5631	5559	·6118	6037	5957	5879	5802	5726	5652	5579	5507	7	9
·6169	6088	6008	5930	5853	5777	5703	5630	5558	·6117	6036	5956	5878	5801	5725	5651	5578	5506	8	10
·6168	6087	6007	5929	5852	5776	5702	5629	5557	·6117	6036	5956	5878	5801	5725	5651	5578	5506	9	11
·6168	6087	6007	5929	5852	5776	5702	5629	5556	·6116	6035	5955	5877	5800	5724	5650	5577	5505	10	13
·6167	6086	6006	5928	5851	5775	5701	5628	5556	·6115	6034	5954	5876	5799	5723	5649	5576	5504	11	14
·6166	6085	6005	5927	5850	5774	5700	5627	5555	·6114	6033	5953	5875	5798	5722	5648	5575	5503	12	15
·6165	6084	6004	5926	5849	5773	5699	5626	5554	·6113	6032	5952	5874	5797	5721	5647	5574	5502	13	17
·6164	6083	6003	5925	5848	5772	5698	5625	5553	·6112	6031	5951	5873	5796	5720	5646	5573	5501	14	18
·6163	6082	6002	5924	5847	5771	5697	5624	5552	·6112	6031	5951	5873	5796	5720	5646	5573	5501	15	19
·6162	6081	6001	5923	5846	5770	5696	5623	5551	·6111	6030	5950	5872	5795	5719	5645	5572	5500	16	20
·6161	6080	6000	5922	5845	5769	5695	5622	5550	·6110	6029	5949	5871	5794	5718	5644	5571	5499	17	22
·6161	6080	6000	5922	5845	5769	5695	5622	5550	·6109	6028	5948	5870	5793	5717	5643	5570	5498	18	23
·6160	6079	5999	5921	5844	5768	5694	5621	5549	·6108	6027	5947	5869	5792	5716	5642	5569	5497	19	24
·6159	6078	5998	5920	5843	5767	5693	5620	5548	·6107	6026	5946	5868	5791	5715	5641	5568	5496	20	25
·6158	6077	5997	5919	5842	5766	5692	5619	5547	·6106	6025	5945	5867	5790	5714	5640	5567	5495	21	27
·6157	6076	5996	5918	5841	5765	5691	5618	5546	·6106	6025	5945	5867	5790	5714	5640	5567	5495	22	28
·6156	6075	5995	5917	5840	5764	5690	5617	5545	·6105	6024	5944	5866	5789	5713	5639	5566	5494	23	29
·6155	6074	5994	5916	5839	5763	5689	5616	5544	·6104	6023	5943	5865	5788	5712	5638	5565	5493	24	30
·6154	6073	5993	5915	5838	5762	5688	5615	5543	·6103	6022	5942	5864	5787	5711	5637	5564	5492	25	32
·6154	6073	5993	5915	5838	5762	5688	5615	5543	·6102	6021	5941	5863	5786	5710	5636	5563	5491	26	33
·6153	6072	5992	5914	5837	5761	5687	5614	5542	·6101	6020	5940	5862	5785	5709	5635	5562	5490	27	34
·6152	6071	5991	5913	5836	5760	5686	5613	5541	·6101	6020	5940	5862	5785	5709	5635	5562	5490	28	35
·6151	6070	5990	5912	5835	5759	5685	5612	5540	·6100	6019	5939	5861	5784	5708	5634	5561	5489	29	37
·6150	6069	5989	5911	5834	5758	5684	5611	5539	·6099	6018	5938	5860	5783	5707	5633	5560	5488	30	38
·6149	6068	5988	5910	5833	5757	5683	5610	5538	·6098	6017	5937	5859	5782	5706	5632	5559	5487	31	39
·6148	6067	5987	5909	5832	5756	5682	5609	5537	·6097	6016	5936	5858	5781	5705	5631	5558	5486	32	41
·6147	6066	5986	5908	5831	5755	5681	5608	5536	·6096	6015	5935	5857	5780	5704	5630	5557	5485	33	42
·6147	6066	5986	5908	5831	5755	5681	5608	5536	·6096	6015	5935	5856	5780	5704	5630	5557	5485	34	43
·6146	6065	5985	5907	5830	5754	5680	5607	5535	·6095	6914	5934	5856	5779	5703	5629	5556	5484	35	44
·6145	6064	5984	5906	5829	5753	5679	5606	5534	·6094	6013	5933	5855	5778	5702	5628	5555	5483	36	45
·6144	6063	5983	5905	5828	5752	5678	5605	5533	·6093	6012	5932	5854	5777	5701	5627	5554	5482	37	47
·6143	6062	5982	5904	5827	5751	5677	5604	5532	·6092	6011	5931	5853	5776	5700	5626	5553	5481	38	48
·6142	6061	5981	5903	5826	5750	5676	5603	5531	·6091	6010	5930	5852	5775	5699	5625	5552	5480	39	49
·6141	6060	5980	5902	5825	5749	5675	5602	5530	·6091	6010	5930	5852	5775	5699	5625	5552	5480	40	51
·6141	6060	5980	5902	5825	5749	5675	5602	5530	·6090	6009	5929	5851	5774	5698	5624	5551	5479	41	52
·6140	6059	5979	5901	5824	5748	5674	5601	5529	·6089	6008	5928	5850	5773	5697	5623	5550	5478	42	53
·6139	6058	5978	5900	5823	5747	5673	5600	5528	·6088	6007	5927	5849	5772	5696	5622	5549	5477	43	54
·6138	6057	5977	5899	5822	5746	5672	5599	5527	·6087	6006	5926	5848	5771	5695	5621	5548	5476	44	56
·6137	6056	5976	5898	5821	5745	5671	5598	5526	·6086	6005	5925	5847	5770	5694	5620	5547	5475	45	57
·6136	6055	5975	5897	5820	5744	5670	5597	5525	·6086	6005	5925	5847	5770	5694	5620	5547	5475	46	58
·6135	6054	5974	5896	5819	5743	5669	5596	5524	·6085	6004	5924	5846	5769	5693	5619	5546	5474	47	59
·6135	6054	5974	5896	5819	5743	5669	5596	5524	·6084	6003	5923	5845	5768	5692	5618	5545	5473	48	61
·6134	6053	5973	5895	5818	5742	5668	5595	5523	·6083	6002	5922	5844	5767	5691	5617	5544	5472	49	62
·6133	6052	5972	5894	5817	5741	5667	5594	5522	·6082	6001	5921	5843	5766	5690	5616	5543	5471	50	63
·6132	6051	5971	5893	5816	5740	5666	5593	5521	·6081	6000	5920	5842	5765	5689	5615	5542	5470	51	64
·6131	6050	5970	5892	5815	5739	5665	5592	5520	·6081	6000	5920	5842	5765	5689	5615	5542	5470	52	66
·6130	6049	5969	5891	5814	5738	5664	5591	5519	·6080	5999	5919	5841	5764	5688	5614	5541	5469	53	67
·6129	6048	5968	5890	5813	5737	5663	5590	5518	·6079	5998	5918	5840	5763	5687	5613	5540	5468	54	68
·6129	6048	5968	5890	5813	5737	5663	5590	5518	·6078	5997	5917	5839	5762	5686	5612	5539	5467	55	69
·6128	6047	5967	5889	5812	5736	5662	5589	5517	·6077	5996	5916	5838	5761	5685	5611	5538	5466	56	71
·6127	6046	5966	5888	5811	5735	5661	5588	5516	·6077	5996	5916	5838	5761	5685	5611	5538	5466	57	72
·6126	6045	5965	5887	5810	5734	5660	5587	5515	·6076	5995	5915	5837	5760	5684	5610	5537	5465	58	73
·6125	6044	5964	5886	5809	5733	5659	5586	5514	·6075	5994	5914	5836	5759	5683	5609	5536	5464	59	74
53'	54'	55'	56'	57'	58'	59'	60'	61'	53'	54'	55'	56'	57'	58'	59'	60'	61'		

TABLE 34

Logarithms of the Apparent Altitudes and Horizontal Parallax.

′	Apparent Altitude 57°									Apparent Altitude 58°									′ or ″	P.P.
	Moon's Horizontal Parallax.									Moon's Horizontal Parallax.										
′	53′	54′	55′	56′	57′	58′	59′	60′	61′	53′	54′	55′	56′	57′	58′	59′	60′	61′		
0	0·6074	5993	5913	5835	5758	5682	5608	5535	5463	0·6026	5945	5865	5787	5710	5634	5560	5487	5415	0	0
1	·6073	5992	5912	5834	5757	5681	5607	5534	5462	·6025	5944	5864	5786	5709	5633	5559	5486	5414	1	
2	·6072	5991	5911	5833	5756	5680	5606	5533	5461	·6024	5943	5863	5785	5708	5632	5558	5485	5413	2	3
3	·6072	5991	5911	5833	5756	5680	5606	5533	5461	·6023	5942	5862	5784	5707	5631	5557	5485	5412	3	4
4	·6071	5990	5910	5832	5755	5679	5605	5532	5460	·6023	5942	5862	5784	5707	5631	5557	5484	5412	4	
5	·6070	5989	5909	5831	5754	5678	5604	5531	5459	·6022	5941	5861	5783	5706	5630	5556	5483	5411	5	6
6	·6069	5988	5908	5830	5753	5677	5603	5530	5458	·6021	5940	5860	5782	5705	5629	5555	5482	5410	6	
7	·6068	5987	5907	5829	5752	5676	5602	5529	5457	·6020	5939	5859	5781	5704	5628	5554	5481	5409	7	9
8	·6068	5987	5907	5829	5752	5676	5602	5529	5457	·6019	5938	5858	5780	5703	5627	5553	5480	5408	8	10
9	·6067	5986	5906	5828	5751	5675	5601	5528	5456	·6018	5937	5857	5779	5702	5626	5552	5479	5407	9	11
10	·6066	5985	5905	5827	5750	5674	5600	5527	5455	·6017	5936	5856	5778	5701	5625	5551	5478	5406	10	13
11	·6065	5984	5904	5826	5749	5673	5599	5526	5454	·6016	5935	5855	5777	5700	5624	5550	5477	5405	11	14
12	·6064	5983	5903	5825	5748	5672	5598	5525	5453	·6016	5935	5855	5777	5700	5624	5550	5477	5405	12	
13	·6063	5982	5902	5824	5747	5671	5597	5524	5452	·6015	5934	5854	5776	5699	5623	5549	5476	5404	13	
14	·6063	5982	5902	5824	5747	5671	5597	5524	5452	·6014	5933	5853	5775	5698	5622	5548	5475	5403	14	
15	·6062	5981	5901	5823	5746	5670	5596	5523	5451	·6013	5932	5852	5774	5697	5621	5547	5474	5402	15	
16	·6061	5980	5900	5822	5745	5669	5595	5522	5450	·6013	5932	5852	5774	5697	5621	5547	5474	5402	16	
17	·6060	5979	5899	5821	5744	5668	5594	5521	5449	·6012	5931	5851	5773	5696	5620	5546	5473	5401	17	
18	·6059	5978	5898	5820	5743	5667	5593	5520	5448	·6012	5931	5851	5773	5696	5620	5546	5473	5401	18	
19	·6059	5978	5898	5820	5743	5667	5593	5520	5448	·6011	5930	5850	5772	5695	5619	5545	5472	5400	19	
20	·6058	5977	5897	5819	5742	5666	5592	5519	5447	·6010	5929	5849	5771	5694	5618	5544	5471	5399	20	
21	·6057	5976	5896	5818	5741	5665	5591	5518	5446	·6009	5928	5848	5770	5693	5617	5543	5470	5398	21	
22	·6056	5975	5895	5817	5740	5664	5590	5517	5445	·6009	5928	5848	5770	5693	5617	5543	5470	5398	22	
23	·6055	5974	5894	5816	5739	5663	5589	5516	5444	·6008	5927	5847	5769	5692	5616	5542	5469	5397	23	
24	·6055	5974	5894	5816	5739	5663	5589	5516	5444	·6007	5926	5846	5768	5691	5615	5541	5468	5396	24	
25	·6054	5973	5893	5815	5738	5662	5588	5515	5443	·6006	5925	5845	5767	5690	5614	5540	5467	5395	25	
26	·6053	5972	5892	5814	5737	5661	5587	5514	5442	·6005	5924	5844	5766	5689	5613	5539	5466	5394	26	
27	·6052	5971	5891	5813	5736	5660	5586	5513	5441	·6005	5924	5844	5766	5689	5613	5539	5466	5394	27	
28	·6051	5970	5890	5812	5735	5659	5585	5512	5440	·6004	5923	5843	5765	5688	5612	5538	5465	5393	28	
29	·6051	5970	5890	5812	5735	5659	5585	5512	5440	·6003	5922	5842	5764	5687	5611	5537	5464	5392	29	
30	·6050	5969	5889	5811	5734	5658	5584	5511	5439	·6002	5921	5841	5763	5686	5610	5536	5463	5391	30	
31	·6049	5968	5888	5810	5733	5657	5583	5510	5438	·6002	5921	5840	5762	5685	5609	5535	5462	5390	31	39
32	·6048	5967	5887	5809	5732	5656	5582	5509	5437	·6001	5920	5839	5761	5684	5608	5534	5461	5389	32	41
33	·6047	5966	5886	5808	5731	5655	5581	5508	5436	·6000	5919	5839	5761	5684	5608	5534	5461	5389	33	42
34	·6046	5965	5885	5808	5730	5654	5580	5507	5435	·5999	5918	5838	5760	5683	5607	5533	5460	5388	34	43
35	·6046	5965	5885	5807	5730	5654	5580	5507	5435	·5998	5917	5837	5759	5682	5606	5532	5459	5387	35	44
36	·6045	5964	5884	5806	5729	5653	5579	5506	5434	·5998	5917	5837	5759	5682	5606	5532	5459	5387	36	
37	·6044	5963	5883	5805	5728	5652	5578	5505	5433	·5997	5916	5836	5758	5681	5605	5531	5458	5386	37	47
38	·6043	5962	5882	5804	5727	5651	5577	5504	5432	·5996	5915	5835	5757	5680	5604	5530	5457	5385	38	48
39	·6042	5961	5881	5803	5726	5650	5576	5503	5431	·5995	5914	5834	5756	5679	5603	5529	5456	5384	39	49
40	·6042	5961	5881	5803	5726	5650	5576	5503	5431	·5995	5914	5834	5756	5679	5603	5529	5456	5384	40	
41	·6041	5960	5880	5802	5725	5649	5575	5502	5430	·5994	5913	5833	5755	5678	5602	5528	5455	5383	41	
42	·6040	5959	5879	5801	5724	5648	5574	5501	5429	·5993	5912	5832	5754	5677	5601	5527	5454	5382	42	
43	·6039	5958	5878	5800	5723	5647	5573	5500	5428	·5992	5911	5831	5753	5676	5600	5526	5453	5381	43	
44	·6038	5957	5877	5799	5722	5646	5572	5499	5427	·5992	5911	5831	5753	5676	5600	5526	5453	5381	44	
45	·6038	5957	5877	5799	5722	5646	5572	5499	5427	·5991	5910	5830	5752	5675	5599	5525	5452	5380	45	
46	·6037	5956	5876	5798	5721	5645	5571	5498	5426	·5990	5909	5829	5751	5674	5598	5524	5451	5379	46	
47	·6036	5955	5875	5797	5720	5644	5570	5497	5425	·5989	5908	5828	5750	5673	5597	5523	5450	5378	47	59
48	·6035	5954	5874	5796	5719	5643	5569	5496	5424	·5988	5907	5827	5749	5672	5596	5522	5449	5377	48	61
49	·6035	5954	5874	5796	5719	5643	5569	5496	5424	·5988	5907	5827	5749	5672	5596	5522	5449	5377	49	62
50	·6034	5953	5873	5795	5718	5642	5568	5495	5423	·5987	5906	5826	5748	5671	5595	5521	5448	5376	50	63
51	·6033	5952	5872	5794	5717	5641	5567	5494	5422	·5986	5905	5825	5747	5670	5594	5520	5447	5375	51	64
52	·6032	5951	5871	5793	5716	5640	5566	5493	5421	·5985	5904	5824	5746	5669	5593	5519	5446	5374	52	66
53	·6031	5950	5870	5792	5715	5639	5565	5492	5420	·5985	5904	5824	5746	5669	5593	5519	5446	5374	53	67
54	·6031	5950	5870	5792	5715	5639	5565	5492	5420	·5984	5903	5823	5745	5668	5592	5518	5445	5373	54	68
55	·6030	5949	5869	5791	5714	5638	5564	5491	5419	·5983	5902	5822	5744	5667	5591	5517	5444	5372	55	69
56	·6029	5948	5868	5790	5713	5637	5563	5490	5418	·5982	5901	5821	5743	5666	5590	5516	5443	5371	56	71
57	·6028	5947	5867	5789	5712	5636	5562	5489	5417	·5982	5901	5821	5743	5666	5590	5516	5443	5371	57	72
58	·6027	5946	5866	5788	5711	5635	5561	5488	5416	·5981	5900	5820	5742	5665	5589	5515	5442	5370	58	73
59	·6027	5946	5866	5788	5711	5635	5561	5488	5416	·5960	5899	5819	5741	5664	5588	5514	5441	5369	59	74
		54′	55′	56′	57′	58′	59′	60′	61′	53′	54′	55′	56′	57′	58′	59′	60′	61′		

TABLE 34

Logarithms of the Apparent Altitudes and Horizontal Parallax.

Apparent Altitude 59°									Apparent Altitude 60°									′ or ″
Moon's Horizontal Parallax.									Moon's Horizontal Parallax.									
53′	54′	55′	56′	57′	58′	59′	60′	61′	53′	54′	55′	56′	57′	58′	59′	60′	61′	
0·5979	5898	5818	5740	5663	5587	5513	5440	5368	0·5935	5854	5774	5696	5619	5543	5469	5396	5324	0
·5979	5898	5818	5740	5663	5587	5513	5440	5368	·5934	5853	5773	5695	5618	5542	5468	5395	5323	1
·5978	5897	5817	5739	5662	5586	5512	5439	5367	·5933	5852	5772	5694	5617	5541	5467	5394	5322	2
·5977	5896	5816	5738	5661	5585	5511	5438	5366	·5933	5852	5772	5694	5617	5541	5467	5394	5322	3
·5976	5895	5815	5737	5660	5584	5510	5437	5365	·5932	5851	5771	5693	5616	5540	5466	5392	5321	4
·5976	5895	5815	5737	5660	5584	5510	5437	5365	·5931	5850	5770	5692	5615	5539	5465	5393	5320	5
·5975	5894	5814	5736	5659	5583	5509	5436	5364	·5930	5849	5769	5691	5614	5538	5464	5391	5319	6
·5974	5893	5813	5735	5658	5582	5508	5435	5363	·5930	5849	5769	5691	5614	5538	5464	5391	5319	7
·5973	5892	5812	5734	5657	5581	5507	5434	5362	·5929	5848	5768	5990	5613	5537	5463	5390	5318	8
·5973	5892	5812	5734	5657	5581	5507	5434	5362	·5928	5847	5767	5689	5612	5536	5462	5389	5317	9
·5972	5891	5811	5733	5656	5580	5506	5433	5361	·5927	5846	5766	5688	5611	5535	5461	5388	5316	10
·5971	5890	5810	5732	5655	5579	5505	5432	5360	·5927	5846	5766	5688	5611	5535	5461	5388	5316	11
·5970	5889	5809	5731	5654	5578	5504	5431	5359	·5926	5845	5765	5687	5610	5534	5460	5387	5315	12
·5970	5889	5809	5731	5654	5578	5504	5431	5359	·5925	5844	5764	5686	5609	5533	5459	5386	5314	13
·5969	5888	5808	5730	5653	5577	5503	5430	5358	·5925	5844	5764	5686	5609	5533	5459	5386	5314	14
·5968	5887	5807	5729	5652	5576	5502	5429	5357	·5924	5843	5763	5685	5608	5532	5458	5384	5313	15
·5967	5886	5806	5728	5651	5575	5501	5428	5356	·5923	5842	5762	5684	5607	5531	5457	5385	5312	16
·5967	5886	5806	5728	5651	5575	5500	5428	5356	·5922	5841	5761	5683	5606	5530	5456	5383	5311	17
·5966	5885	5805	5727	5650	5574	5500	5427	5355	·5922	5841	5761	5683	5606	5530	5456	5383	5311	18
·5965	5884	5804	5726	5649	5573	5499	5426	5354	·5921	5840	5760	5682	5605	5529	5455	5382	5310	19
·5964	5883	5803	5725	5648	5572	5498	5425	5353	·5920	5839	5759	5681	5604	5528	5454	5881	5309	20
·5964	5883	5803	5725	5648	5572	5498	5425	5353	·5919	5838	5758	5680	5603	5527	5453	5380	5308	21
·5963	5882	5802	5724	5647	5571	5497	5424	5352	·5919	5838	5758	5680	5603	5527	5453	5380	5308	22
·5962	5881	5801	5723	5646	5570	5496	5423	5351	·5918	5837	5757	5679	5602	5526	5452	5379	5307	23
·5961	5880	5800	5722	5645	5569	5495	5422	5350	·5917	5836	5756	5678	5601	5525	5451	5378	5306	24
·5961	5880	5800	5722	5645	5569	5495	5422	5350	·5917	5836	5756	5678	5601	5525	5451	5378	5306	25
·5960	5879	5799	5721	5644	5568	5494	5421	5349	·5916	5835	5755	5677	5600	5524	5450	5377	5305	26
·5959	5878	5798	5720	5643	5567	5493	5420	5348	·5915	5834	5754	5676	5599	5523	5449	5376	5304	27
·5958	5877	5797	5719	5642	5566	5492	5419	5347	·5914	5833	5753	5675	5598	5522	5448	5375	5303	28
·5958	5877	5797	5719	5642	5566	5492	5419	5347	·5914	5833	5753	5675	5598	5522	5448	5375	5303	29
·5957	5876	5796	5718	5641	5565	5491	5418	5346	·5913	5832	5752	5674	5597	5521	5447	5374	5302	30
·5956	5875	5795	5717	5640	5564	5490	5417	5345	·5912	5831	5751	5673	5596	5520	5446	5373	5301	31
·5955	5874	5794	5716	5639	5563	5489	5416	5344	·5911	5830	5750	5672	5595	5519	5445	5372	5300	32
·5955	5874	5794	5716	5639	5563	5489	5416	5344	·5911	5830	5750	5672	5595	5519	5445	5372	5300	33
·5954	5873	5793	5715	5638	5562	5488	5415	5343	·5910	5829	5749	5671	5594	5518	5444	5371	5299	34
·5953	5872	5792	5714	5637	5561	5487	5414	5342	·5909	5828	5748	5670	5593	5517	5443	5370	5298	35
·5952	5871	5791	5713	5636	5560	5487	5413	5341	·5909	5828	5748	5670	5593	5517	5443	5370	5298	36
·5952	5871	5791	5713	5636	5560	5486	5413	5341	·5908	5827	5747	5669	5592	5516	5442	5369	5297	37
·5951	5870	5790	5712	5635	5559	5485	5412	5340	·5907	5826	5746	5668	5591	5515	5441	5368	5296	38
·5950	5869	5789	5711	5634	5558	5484	5411	5339	·5907	5826	5746	5668	5591	5515	5441	5368	5296	39
·5949	5868	5788	5710	5633	5557	5483	5410	5338	·5906	5825	5745	5667	5590	5514	5440	5367	5295	40
·5949	5868	5788	5710	5633	5557	5483	5410	5338	·5905	5824	5744	5666	5589	5513	5439	5366	5294	41
·5948	5867	5787	5709	5632	5556	5482	5409	5337	·5904	5823	5743	5665	5588	5512	5438	5365	5293	42
·5947	5866	5786	5708	5631	5555	5481	5408	5336	·5904	5823	5743	5665	5588	5512	5438	5365	5293	43
·5946	5865	5785	5707	5630	5554	5480	5407	5335	·5903	5822	5742	5664	5587	5511	5437	5364	5292	44
·5946	5865	5785	5707	5630	5554	5480	5407	5335	·5902	5821	5741	5663	5586	5510	5436	5363	5291	45
·5945	5864	5784	5706	5629	5553	5479	5406	5334	·5902	5821	5741	5663	5586	5510	5436	5363	5291	46
·5944	5863	5783	5705	5628	5552	5478	5405	5333	·5901	5820	5740	5662	5585	5509	5435	5362	5290	47
·5943	5862	5782	5704	5627	5551	5477	5404	5332	·5900	5819	5739	5661	5584	5508	5434	5361	5289	4
·5943	5862	5782	5704	5627	5551	5477	5404	5332	·5900	5819	5739	5661	5584	5508	5434	5361	5289	4
·5942	5861	5781	5703	5626	5550	5476	5403	5331	·5899	5818	5738	5660	5583	5507	5133	5360	5288	5
·5941	5860	5780	5702	5625	5549	5475	5402	5330	·5898	5817	5737	5659	5582	5506	5132	5359	5287	5
·5940	5859	5779	5701	5624	5548	5474	5401	5329	·5897	5816	5736	5658	5581	5505	5131	5358	5286	5
·5910	5859	5779	5701	5624	5548	5474	5401	5329	·5897	5816	5736	5658	5581	5505	5431	5358	5286	5
·5939	5858	5778	5700	5623	5547	5473	5400	5328	·5896	5815	5735	5657	5580	5504	5430	5357	5285	5
·5938	5857	5777	5699	5622	5546	5472	5399	5327	·5895	5814	5734	5656	5579	5503	5429	5356	5284	5
·5938	5857	5777	5699	5622	5546	5472	5399	5327	·5895	5814	5734	5655	5579	5503	5429	5356	5284	5
·5937	5856	5776	5698	5621	5545	5471	5398	5326	·5894	5813	5733	5655	5578	5502	5428	5355	5283	5
·5936	5855	5775	5697	5620	5545	5470	5397	5325	·5893	5812	5732	5654	5577	5501	5427	5354	5282	5
·5935	5854	5774	5696	5619	5544	5469	5396	5324	·5893	5812	5732	5654	5577	5501	5427	5354	5282	5
53′	54′	55′	56′	57′	58′	59′	60′	61′	53′	54′	55′	56′	57′	58′	59′	60′	61′	

Logarithms of the Apparent Altitudes and Horizontal Parallax.

Apparent Altitude 61°									Apparent Altitude 62°										
Moon's Horizontal Parallax.									Moon's Horizontal Parallax.									″ or ′	P.P. to ″ of Par.
3′	54′	55′	56′	57′	58′	59′	60′	61′	53′	54′	55′	56′	57′	58′	59′	60′	61′		
892	5811	5731	5653	5576	5500	5426	5353	5281	0 ·5851	5770	5690	5612	5535	5459	5385	5312	5240	0	—0
891	5810	5730	5652	5575	5499	5425	5352	5280	·5850	5769	5689	5611	5534	5458	5384	5311	5239	1	1
890	5809	5729	5651	5574	5498	5424	5351	5279	·5849	5768	5688	5610	5533	5457	5383	5310	5238	2	3
890	5809	5729	5651	5574	5498	5424	5351	5279	·5849	5768	5688	5610	5532	5457	5383	5310	5238	3	4
889	5808	5728	5650	5573	5497	5423	5350	5278	·5848	5767	5687	5609	5532	5456	5382	5309	5237	4	5
888	5807	5727	5649	5572	5496	5422	5349	5277	·5847	5766	5686	5608	5531	5455	5381	5308	5236	5	6
888	5807	5727	5649	5572	5496	5422	5349	5277	·5847	5766	5686	5608	5531	5455	5381	5308	5236	6	8
887	5806	5726	5648	5571	5495	5421	5348	5276	·5846	5765	5685	5607	5530	5454	5380	5307	5235	7	9
886	5805	5725	5647	5570	5494	5420	5347	5275	·5845	5764	5684	5606	5529	5453	5379	5306	5234	8	10
886	5805	5725	5647	5570	5494	5420	5347	5275	·5845	5764	5684	5606	5529	5453	5379	5306	5234	9	11
885	5804	5724	5646	5569	5493	5419	5346	5274	·5844	5763	5683	5605	5528	5452	5378	5305	5233	10	13
884	5803	5723	5645	5568	5492	5418	5345	5273	·5843	5762	5682	5604	5527	5451	5377	5304	5232	11	14
883	5802	5722	5644	5567	5491	5417	5344	5272	·5843	5762	5682	5604	5527	5451	5377	5304	5232	12	15
883	5802	5722	5644	5567	5491	5417	5344	5272	·5842	5761	5681	5603	5526	5450	5376	5303	5231	13	17
882	5801	5721	5643	5566	5490	5416	5343	5271	·5841	5760	5680	5602	5525	5449	5375	5302	5230	14	18
881	5800	5720	5642	5565	5489	5415	5342	5270	·5841	5760	5680	5602	5525	5449	5375	5302	5230	15	19
881	5800	5720	5642	5565	5489	5415	5342	5270	·5840	5759	5679	5601	5524	5448	5374	5301	5229	16	20
880	5799	5719	5641	5564	5488	5414	5341	5269	·5839	5758	5678	5600	5523	5447	5373	5300	5228	17	22
879	5798	5718	5640	5563	5487	5413	5340	5268	·5839	5758	5678	5600	5523	5447	5373	5300	5228	18	23
879	5798	5718	5640	5563	5487	5413	5340	5268	·5838	5757	5677	5599	5522	5446	5372	5299	5227	19	24
878	5797	5717	5639	5562	5486	5412	5339	5267	·5837	5756	5676	5598	5521	5445	5371	5298	5226	20	25
877	5796	5716	5638	5561	5485	5411	5338	5266	·5837	5756	5676	5598	5521	5445	5371	5298	5226	21	27
877	5796	5716	5638	5561	5485	5411	5338	5266	·5836	5755	5675	5597	5520	5444	5370	5297	5225	22	28
876	5795	5715	5637	5560	5484	5410	5337	5265	·5835	5754	5674	5596	5519	5443	5369	5296	5224	23	29
875	5794	5714	5636	5559	5483	5409	5336	5264	·5835	5754	5674	5596	5519	5443	5369	5296	5224	24	30
874	5793	5713	5635	5558	5482	5408	5335	5263	·5834	5753	5673	5595	5518	5442	5368	5295	5223	25	32
874	5793	5713	5635	5558	5482	5408	5335	5263	·5833	5752	5672	5594	5517	5441	5367	5294	5222	26	33
873	5792	5712	5634	5557	5481	5407	5334	5262	·5833	5752	5672	5594	5517	5441	5367	5294	5222	27	34
872	5791	5711	5633	5556	5480	5406	5333	5261	·5832	5751	5671	5593	5516	5440	5366	5293	5221	28	35
872	5791	5711	5633	5556	5480	5406	5333	5261	·5831	5750	5670	5592	5515	5439	5365	5292	5220	29	37
871	5790	5710	5632	5555	5479	5405	5332	5260	·5831	5750	5670	5592	5515	5439	5365	5292	5220	30	38
870	5789	5709	5631	5554	5478	5404	5331	5259	·5830	5749	5669	5591	5514	5438	5364	5291	5219	31	39
870	5789	5709	5631	5554	5478	5404	5331	5259	·5829	5748	5668	5590	5513	5437	5363	5290	5218	32	41
869	5788	5708	5630	5553	5477	5403	5330	5258	·5829	5748	5668	5590	5513	5437	5363	5290	5218	33	42
868	5787	5707	5629	5552	5476	5402	5329	5257	·5828	5747	5667	5589	5512	5436	5362	5289	5217	34	43
868	5787	5707	5629	5552	5476	5402	5329	5257	·5827	5746	5666	5588	5511	5435	5361	5288	5216	35	44
867	5786	5706	5628	5551	5475	5401	5328	5256	·5827	5746	5666	5588	5511	5435	5361	5288	5216	36	45
866	5785	5795	5627	5550	5474	5400	5327	5255	·5826	5745	5665	5587	5510	5434	5360	5287	5215	37	47
866	5785	5705	5627	5550	5474	5400	5327	5255	·5825	5744	5664	5586	5509	5433	5359	5286	5214	38	48
865	5784	5704	5626	5549	5473	5399	5326	5254	·5825	5744	5664	5586	5509	5433	5359	5286	5214	39	49
864	5783	5703	5625	5548	5472	5398	5325	5253	·5824	5743	5663	5585	5508	5432	5358	5285	5213	40	51
863	5782	5702	5625	5548	5472	5398	5325	5253	·5823	5742	5662	5584	5507	5431	5357	5254	5212	41	52
863	5782	5702	5624	5547	5471	5397	5324	5252	·5823	5742	5662	5584	5507	5431	5357	5284	5212	42	53
862	5781	5701	5623	5546	5470	5396	5323	5251	·5822	5741	5661	5583	5506	5430	5356	5283	5211	43	54
861	5780	5700	5622	5545	5469	5395	5322	5250	·5822	5741	5661	5583	5506	5430	5356	5283	5211	44	56
861	5780	5700	5622	5545	5469	5395	5322	5250	·5821	5740	5660	5582	5505	5429	5355	5282	5210	45	57
860	5779	5699	5621	5544	5468	5394	5321	5249	·5820	5739	5659	5581	5504	5428	5354	5281	5209	46	58
859	5778	5698	5620	5543	5467	5393	5320	5248	·5820	5739	5659	5581	5504	5428	5354	5281	5209	47	59
859	5778	5698	5620	5543	5467	5393	5320	5248	·5819	5738	5658	5580	5503	5427	5353	5280	5208	48	61
858	5777	5697	5619	5542	5466	5392	5319	5247	·5818	5737	5657	5579	5502	5426	5352	5279	5207	49	62
857	5776	5696	5618	5541	5465	5391	5318	5246	·5818	5737	5657	5579	5502	5426	5352	5279	5207	50	63
857	5776	5696	5618	5541	5465	5391	5318	5246	·5817	5736	5656	5578	5501	5425	5351	5278	5206	51	64
856	5775	5695	5617	5540	5464	5390	5317	5245	·5816	5735	5655	5577	5500	5424	5350	5277	5205	52	66
855	5774	5694	5616	5539	5463	5389	5316	5244	·5816	5735	5655	5577	5500	5424	5350	5277	5205	53	67
855	5774	5694	5616	5539	5463	5389	5316	5244	·5815	5734	5654	5576	5499	5423	5349	5276	5204	54	68
854	5773	5693	5615	5538	5462	5388	5315	5243	·5814	5733	5653	5575	5498	5422	5348	5275	5203	55	69
853	5772	5692	5614	5537	5461	5387	5314	5242	·5814	5733	5653	5575	5498	5422	5348	5275	5203	56	71
853	5772	5692	5614	5537	5461	5387	5314	5242	·5813	5732	5652	5574	5497	5421	5347	5274	5202	57	72
852	5771	5691	5613	5536	5460	5386	5313	5241	·5812	5731	5651	5573	5496	5420	5346	5273	5201	58	73
851	5770	5690	5612	5535	5459	5385	5312	5240	·5812	5731	5651	5573	5496	5420	5346	5273	5201	59	74
3′	54′	55′	56′	57′	58′	59′	60′	61′	53′	54′	55′	56′	57′	58′	59′	60′	61′		

TABLE 34

Logarithms of the Apparent Altitudes and Horizontal Parallax.

Apparent Altitude 63°									Apparent Altitude 64°									′ or ″	P.P. to ″ of Par.
Moon's Horizontal Parallax.									Moon's Horizontal Parallax.										
53′	54′	55′	56′	57′	58′	59′	60′	61′	53′	54′	55′	56′	57′	58′	59′	60′	61′		
0 ·5811	5730	5650	5572	5495	5419	5345	5272	5200	0 ·5774	5692	5612	5534	5457	5381	5307	5234	5162	0	—0
·5811	5730	5650	5572	5495	5419	5345	5272	5200	·5773	5692	5612	5534	5457	5381	5307	5234	5162	1	1
·5810	5729	5649	5571	5494	5418	5344	5271	5199	·5773	5691	5611	5533	5456	5380	5306	5233	5161	2	3
·5809	5728	5648	5570	5493	5417	5343	5270	5198	·5772	5691	5611	5533	5456	5380	5306	5233	5161	3	4
·5809	5728	5648	5570	5493	5417	5343	5270	5198	·5772	5690	5610	5532	5455	5379	5305	5232	5160	4	5
·5808	5727	5647	5569	5492	5416	5342	5269	5197	·5771	5689	5609	5531	5454	5378	5304	5231	5159	5	6
·5807	5726	5646	5568	5491	5415	5341	5268	5196	·5770	5689	5609	5531	5454	5378	5304	5231	5159	6	8
·5807	5726	5646	5568	5491	5415	5341	5268	5196	·5769	5688	5608	5530	5453	5377	5303	5230	5158	7	9
·5806	5725	5645	5567	5490	5414	5340	5267	5195	·5768	5687	5607	5529	5452	5376	5302	5229	5157	8	10
·5805	5724	5644	5566	5489	5413	5339	5266	5194	·5768	5687	5607	5529	5452	5376	5302	5229	5157	9	11
·5805	5724	5644	5566	5489	5413	5339	5266	5194	·5767	5686	5606	5528	5451	5375	5301	5228	5156	10	13
·5804	5723	5643	5565	5488	5412	5338	5265	5193	·5767	5686	5606	5528	5451	5375	5301	5228	5156	11	14
·5803	5722	5642	5564	5487	5411	5337	5264	5192	·5766	5685	5605	5527	5450	5374	5300	5227	5155	12	15
·5803	5722	5642	5564	5487	5411	5337	5264	5192	·5765	5684	5604	5526	5449	5373	5299	5226	5154	13	17
·5802	5721	5641	5563	5486	5410	5336	5263	5191	·5765	5684	5604	5526	5449	5373	5299	5226	5154	14	18
·5802	5721	5641	5563	5486	5410	5336	5263	5191	·5764	5683	5603	5525	5448	5372	5298	5225	5153	15	19
·5801	5720	5640	5562	5485	5409	5335	5262	5190	·5764	5683	5603	5525	5448	5372	5298	5225	5153	16	20
·5800	5719	5639	5561	5484	5408	5334	5261	5189	·5763	5682	5602	5524	5447	5371	5297	5224	5152	17	22
·5800	5719	5639	5561	5484	5408	5334	5261	5189	·5762	5681	5601	5523	5446	5370	5296	5223	5151	18	23
·5799	5718	5638	5560	5483	5407	5333	5260	5188	·5762	5681	5601	5523	5446	5370	5296	5223	5151	19	24
·5798	5717	5637	5559	5482	5406	5332	5259	5187	·5761	5680	5600	5522	5445	5369	5295	5222	5150	20	25
·5798	5717	5637	5559	5482	5406	5332	5259	5187	·5761	5680	5600	5522	5445	5369	5295	5222	5150	21	27
·5797	5716	5636	5558	5481	5405	5331	5258	5186	·5760	5679	5599	5521	5444	5368	5294	5221	5149	22	28
·5797	5716	5636	5558	5481	5495	5331	5258	5185	·5759	5678	5598	5520	5443	5367	5293	5220	5148	23	29
·5796	5715	5635	5557	5480	5404	5330	5257	5185	·5759	5678	5598	5520	5443	5367	5293	5220	5148	24	30
·5795	5714	5634	5556	5479	5403	5329	5256	5184	·5758	5677	5597	5519	5442	5366	5292	5219	5147	25	32
·5795	5714	5634	5556	5479	5403	5329	5256	5184	·5758	5677	5597	5519	5442	5366	5292	5219	5147	26	33
·5794	5713	5633	5555	5478	5402	5328	5255	5183	·5757	5676	5596	5518	5441	5365	5291	5218	5146	27	34
·5793	5712	5632	5554	5477	5401	5327	5254	5182	·5756	5675	5595	5517	5440	5364	5290	5217	5145	28	35
·5793	5712	5632	5554	5477	5401	5327	5254	5182	·5756	5675	5595	5517	5440	5364	5290	5217	5145	29	37
·5792	5711	5631	5553	5476	5400	5326	5253	5181	·5755	5674	5594	5516	5439	5363	5289	5216	5144	30	38
·5791	5710	5630	5552	5475	5399	5325	5252	5180	·5755	5674	5594	5516	5439	5363	5289	5216	5144	31	39
·5791	5710	5630	5552	5475	5399	5325	5252	5180	·5754	5673	5593	5515	5438	5362	5288	5215	5143	32	41
·5790	5709	5629	5551	5474	5398	5324	5251	5179	·5753	5672	5592	5514	5437	5361	5287	5214	5142	33	42
·5790	5709	5629	5551	5474	5398	5324	5251	5179	·5753	5672	5592	5514	5437	5361	5287	5214	5142	34	43
·5789	5708	5628	5550	5473	5397	5323	5250	5178	·5752	5671	5591	5513	5436	5360	5286	5213	5141	35	44
·5788	5707	5627	5549	5472	5396	5322	5249	5177	·5752	5671	5591	5513	5436	5360	5286	5213	5141	36	45
·5788	5707	5627	5549	5472	5396	5322	5249	5177	·5751	5670	5590	5512	5435	5359	5285	5212	5140	37	47
·5787	5706	5626	5548	5471	5395	5321	5248	5176	·5750	5669	5589	5511	5434	5358	5284	5211	5139	38	48
·5786	5705	5625	5547	5470	5394	5320	5247	5175	·5750	5669	5589	5511	5434	5358	5284	5211	5139	39	49
·5786	5705	5625	5547	5470	5394	5320	5247	5175	·5749	5668	5588	5510	5433	5357	5283	5210	5138	40	51
·5785	5704	5624	5546	5469	5393	5319	5246	5174	·5749	5668	5588	5510	5433	5357	5283	5210	5138	41	52
·5785	5704	5624	5546	5469	5393	5319	5246	5174	·5748	5667	5587	5509	5432	5356	5282	5209	5137	42	53
·5784	5703	5623	5545	5468	5392	5318	5245	5173	·5747	5666	5586	5508	5431	5355	5281	5208	5136	43	54
·5783	5702	5622	5544	5467	5391	5317	5244	5172	·5747	5666	5586	5508	5431	5355	5281	5208	5136	44	56
·5783	5702	5622	5544	5467	5391	5317	5244	5172	·5746	5665	5585	5507	5430	5354	5280	5207	5135	45	57
·5782	5701	5621	5543	5466	5390	5316	5243	5171	·5746	5665	5585	5507	5430	5354	5280	5207	5135	46	58
·5781	5700	5620	5542	5465	5389	5315	5242	5170	·5745	5664	5584	5506	5429	5353	5279	5206	5134	47	59
·5781	5700	5620	5542	5465	5389	5315	5242	5170	·5744	5663	5583	5505	5428	5352	5278	5205	5133	48	61
·5780	5699	5619	5541	5464	5388	5314	5241	5169	·5744	5663	5583	5505	5428	5352	5278	5205	5133	49	62
·5780	5699	5619	5541	5464	5388	5314	5241	5169	·5743	5662	5582	5504	5427	5351	5277	5204	5132	50	63
·5779	5698	5618	5540	5463	5387	5313	5240	5168	·5743	5662	5582	5504	5427	5351	5276	5204	5132	51	64
·5778	5697	5617	5539	5462	5386	5312	5239	5167	·5742	5661	5581	5503	5426	5350	5276	5203	5131	52	66
·5778	5697	5617	5539	5462	5386	5312	5239	5167	·5741	5660	5580	5502	5425	5349	5275	5202	5130	53	67
·5777	5696	5616	5538	5461	5385	5311	5238	5166	·5741	5660	5580	5502	5425	5349	5274	5202	5130	54	68
·5776	5695	5615	5537	5460	5384	5310	5237	5165	·5740	5659	5579	5501	5424	5348	5274	5201	5129	55	69
·5776	5695	5615	5537	5460	5384	5310	5237	5165	·5740	5659	5579	5501	5424	5348	5273	5201	5129	56	71
·5775	5694	5614	5536	5459	5383	5309	5236	5164	·5739	5658	5578	5500	5423	5347	5273	5200	5128	57	72
5775	5694	5614	5536	5459	5383	5309	5236	5164	·5738	5657	5577	5499	5422	5346	5272	5199	5127	58	73
·5774	5693	5613	5535	5458	5382	5308	5235	5163	·5738	5657	5577	5499	5422	5346	5272	5199	5127	59	74
53′	54′	55′	56′	57′	58′	59′	60′	61′	53′	54′	55′	56′	57′	58′	59′	60′	61′		

TABLE 34

Logarithms of the Apparent Altitudes and Horizontal Parallax.

′	Apparent Altitude 65°									Apparent Altitude 66°									′ or ″
	Moon's Horizontal Parallax.									Moon's Horizontal Parallax.									
	53′	54′	55′	56′	57′	58′	59′	60′	61′	53′	54′	55′	56′	57′	58′	59′	60′	61′	
0	0·5737	5656	5576	5498	5421	5345	5271	5198	5126	0·5703	5622	5542	5464	5387	5311	5237	5164	5092	0
1	·5737	5656	5576	5498	5421	5345	5271	5198	5126	·5702	5621	5541	5463	5386	5310	5236	5163	5091	1
2	·5736	5655	5575	5497	5420	5344	5270	5197	5125	·5702	5621	5541	5463	5386	5310	5236	5163	5091	2
3	·5735	5654	5574	5496	5419	5343	5269	5196	5124	·5701	5620	5540	5462	5385	5309	5235	5162	5090	3
4	·5735	5654	5574	5496	5419	5343	5269	5196	5124	·5700	5619	5539	5461	5384	5308	5234	5161	5089	4
5	·5734	5653	5573	5495	5418	5342	5268	5195	5123	·5700	5619	5539	5461	5384	5308	5234	5161	5089	5
6	·5734	5653	5573	5495	5418	5342	5268	5195	5123	·5699	5618	5538	5460	5383	5307	5233	5160	5088	6
7	·5733	5652	5572	5494	5417	5341	5267	5194	5122	·5699	5618	5538	5460	5383	5307	5233	5160	5088	7
8	·5733	5652	5572	5494	5417	5341	5267	5194	5122	·5698	5617	5537	5459	5382	5306	5232	5159	5087	8
9	·5732	5651	5571	5493	5416	5340	5266	5193	5121	·5698	5617	5537	5459	5382	5306	5232	5159	5087	9
10	·5731	5650	5570	5492	5415	5339	5265	5192	5120	·5697	5616	5536	5458	5381	5305	5231	5158	5086	10
11	·5731	5650	5570	5492	5415	5339	5265	5192	5120	·5697	5616	5536	5458	5381	5305	5231	5158	5086	11
12	·5730	5649	5569	5491	5414	5338	5264	5191	5119	·5696	5615	5535	5457	5380	5304	5230	5157	5085	12
13	·5730	5649	5569	5491	5414	5338	5264	5191	5119	·5695	5614	5534	5456	5379	5303	5229	5156	5084	13
14	·5729	5648	5568	5490	5413	5337	5263	5190	5118	·5695	5614	5534	5456	5379	5303	5229	5156	5084	14
15	·5728	5647	5567	5489	5412	5336	5262	5189	5117	·5694	5613	5533	5455	5378	5302	5228	5155	5083	15
16	·5728	5647	5567	5489	5412	5336	5262	5189	5117	·5694	5613	5533	5455	5378	5302	5228	5155	5083	16
17	·5727	5646	5566	5488	5411	5335	5261	5188	5116	·5693	5612	5532	5454	5377	5301	5227	5154	5082	17
18	·5727	5646	5566	5488	5411	5335	5261	5188	5116	·5693	5612	5532	5454	5377	5301	5227	5154	5082	18
19	·5726	5645	5565	5487	5410	5334	5260	5187	5115	·5692	5611	5531	5453	5376	5300	5226	5153	5081	19
20	·5725	5644	5564	5486	5409	5333	5259	5186	5114	·5692	5611	5531	5453	5376	5300	5226	5153	5081	20
21	·5725	5644	5564	5486	5409	5333	5259	5186	5114	·5691	5610	5530	5452	5375	5299	5225	5152	5080	21
22	·5724	5643	5563	5485	5408	5332	5258	5185	5113	·5690	5609	5529	5451	5374	5298	5224	5151	5079	22
23	·5724	5643	5563	5485	5408	5332	5258	5185	5113	·5690	5609	5529	5451	5374	5298	5224	5151	5079	23
24	·5723	5642	5562	5484	5407	5331	5257	5184	5112	·5689	5608	5528	5450	5373	5297	5223	5150	5078	24
25	·5723	5642	5562	5484	5407	5331	5257	5184	5112	·5689	5608	5528	5450	5373	5297	5223	5150	5078	25
26	·5722	5641	5561	5483	5406	5330	5256	5183	5111	·5688	5607	5527	5449	5372	5296	5222	5149	5077	26
27	·5721	5640	5560	5482	5405	5329	5255	5182	5110	·5688	5607	5527	5449	5372	5296	5222	5149	5077	27
28	·5721	5640	5560	5482	5405	5329	5255	5182	5110	·5687	5606	5526	5448	5371	5295	5221	5148	5076	28
29	·5720	5639	5559	5481	5404	5328	5254	5181	5109	·5687	5606	5526	5448	5371	5295	5221	5148	5076	29
30	·5720	5639	5559	5481	5404	5328	5254	5181	5109	·5686	5605	5525	5447	5370	5294	5220	5147	5075	30
31	·5720	5638	5558	5480	5403	5327	5253	5180	5108	·5685	5604	5524	5446	5369	5293	5219	5146	5074	31
32	·5719	5638	5558	5480	5403	5327	5253	5180	5108	·5685	5604	5524	5446	5369	5293	5219	5146	5074	32
33	·5718	5637	5557	5479	5402	5326	5252	5179	5107	·5684	5603	5523	5445	5368	5292	5218	5145	5073	33
34	·5717	5636	5556	5478	5401	5325	5251	5178	5106	·5684	5603	5523	5445	5368	5292	5218	5145	5073	34
35	·5717	5636	5556	5478	5401	5325	5251	5178	5106	·5683	5602	5522	5444	5367	5291	5217	5144	5072	35
36	·5716	5635	5555	5477	5400	5324	5250	5177	5105	·5683	5602	5522	5444	5367	5291	5217	5144	5072	36
37	·5716	5635	5555	5477	5400	5324	5250	5177	5105	·5682	5601	5521	5443	5366	5290	5216	5143	5071	37
38	·5715	5634	5554	5476	5399	5323	5249	5176	5104	·5682	5601	5521	5443	5366	5290	5216	5143	5071	38
39	·5715	5634	5554	5476	5399	5323	5249	5176	5104	·5681	5600	5520	5442	5365	5289	5215	5142	5070	39
40	·5714	5633	5553	5475	5398	5322	5248	5175	5103	·5681	5600	5520	5442	5365	5289	5215	5142	5070	40
41	·5713	5632	5552	5474	5397	5321	5247	5174	5102	·5680	5599	5519	5441	5364	5288	5214	5141	5069	41
42	·5713	5632	5552	5474	5397	5321	5247	5174	5102	·5680	5599	5519	5441	5364	5288	5214	5141	5069	42
43	·5712	5631	5551	5473	5396	5320	5246	5173	5101	·5679	5598	5518	5440	5363	5287	5213	5140	5068	43
44	·5712	5631	5551	5473	5396	5320	5246	5173	5101	·5679	5598	5518	5440	5363	5287	5213	5140	5068	44
45	·5711	5630	5550	5472	5395	5319	5245	5172	5100	·5678	5597	5517	5439	5362	5286	5212	5139	5067	45
46	·5711	5630	5550	5472	5395	5319	5245	5172	5100	·5678	5597	5517	5439	5362	5286	5212	5139	5067	46
47	·5710	5629	5549	5471	5394	5318	5244	5171	5099	·5677	5596	5516	5438	5361	5285	5211	5138	5066	47
48	·5709	5628	5548	5470	5393	5317	5243	5170	5098	·5676	5595	5515	5437	5360	5284	5210	5137	5065	48
49	·5709	5628	5548	5470	5393	5317	5243	5170	5098	·5676	5595	5515	5437	5360	5284	5210	5137	5065	49
50	·5708	5627	5547	5469	5392	5316	5242	5169	5097	·5675	5594	5514	5436	5359	5283	5209	5136	5064	50
51	·5708	5627	5547	5469	5392	5316	5242	5169	5097	·5675	5594	5514	5436	5359	5283	5209	5136	5064	51
52	·5707	5626	5546	5468	5391	5315	5241	5168	5096	·5674	5593	5513	5435	5358	5282	5208	5135	5063	52
53	·5707	5626	5546	5468	5391	5315	5241	5168	5096	·5673	5592	5512	5434	5357	5281	5207	5134	5062	53
54	·5706	5625	5545	5467	5390	5314	5240	5167	5095	·5673	5592	5512	5434	5357	5281	5207	5134	5062	54
55	·5706	5625	5545	5467	5390	5314	5240	5167	5095	·5672	5591	5511	5433	5356	5280	5206	5133	5061	55
56	·5705	5624	5544	5466	5389	5313	5239	5166	5094	·5672	5591	5511	5433	5356	5280	5206	5133	5061	56
57	·5704	5623	5543	5465	5388	5312	5238	5165	5093	·5671	5590	5510	5432	5355	5279	5205	5132	5060	57
58	·5704	5623	5543	5465	5388	5312	5238	5165	5093	·5671	5590	5510	5432	5355	5279	5205	5132	5060	58
59	·5703	5622	5542	5464	5387	5311	5237	5164	5092	·5670	5589	5509	5431	5354	5278	5204	5131	5059	59
	53′	54′	55′	56′	57′	58′	59′	60′	61′	53′	54′	55′	56′	57′	58′	59′	60′	61′	

TABLE 34

Logarithms of the Apparent Altitudes and Horizontal Parallax.

Apparent Altitude 67°									Apparent Altitude 68°									′ or ″	P.P. to ″ of Par.
Moon's Horizontal Parallax.									Moon's Horizontal Parallax.										
53′	54′	55′	56′	57′	58′	59′	60′	61′	53′	54′	55′	56′	57′	58′	59′	60′	61′		
·5670	5589	5509	5431	5354	5278	5204	5131	5059	0·5638	5557	5477	5399	5322	5246	5172	5099	5027	0	—0
·5669	5588	5508	5430	5353	5277	5203	5130	5058	·5638	5557	5477	5399	5322	5246	5172	5099	5027	1	1
·5669	5588	5508	5430	5353	5277	5203	5130	5058	·5637	5556	5476	5398	5321	5245	5171	5098	5026	2	3
·5668	5587	5507	5429	5352	5276	5202	5129	5057	·5637	5556	5476	5398	5321	5245	5171	5098	5026	3	4
·5668	5587	5507	5429	5352	5276	5202	5129	5057	·5636	5555	5475	5397	5320	5244	5170	5097	5025	4	5
·5667	5586	5506	5428	5351	5275	5201	5128	5056	·5636	5555	5475	5397	5320	5241	5170	5097	5025	5	6
·5666	5585	5505	5427	5350	5274	5200	5127	5055	·5635	5554	5474	5396	5319	5243	5169	5096	5024	6	8
·5666	5585	5505	5427	5350	5274	5200	5127	5055	·5635	5554	5474	5396	5319	5243	5169	5096	5024	7	9
·5665	5584	5504	5426	5349	5273	5199	5126	5054	·5634	5553	5473	5395	5318	5242	5168	5095	5023	8	10
·5665	5584	5504	5426	5349	5273	5199	5126	5054	·5634	5553	5473	5395	5318	6242	5168	5095	5023	9	11
·5664	5583	5503	5425	5348	5272	5198	5125	5053	·5633	5552	5472	5394	5317	6241	5167	5094	5022	10	13
·5664	5583	5503	5425	5348	5272	5198	5125	5053	·5633	5552	5472	5394	5317	5241	5167	5094	5022	11	14
·5663	5582	5502	5424	5347	5271	5197	5124	5052	·5632	5551	5471	5393	5316	5240	5166	5093	5021	12	15
·5663	5582	5502	5424	5347	5271	5197	5124	5052	·5632	5551	5471	5393	5316	5240	5166	5093	5021	13	17
·5662	5581	5501	5423	5346	5270	5196	5123	5051	·5631	5550	5470	5392	5315	6239	5165	5092	5020	14	18
·5662	5581	5501	5423	5346	5270	5196	5123	5051	·5631	5550	5470	5392	5315	5239	5165	5092	5020	15	19
·5661	5580	5500	5422	5345	5269	5195	5122	5050	·5630	5549	5469	5391	5314	5238	5164	5091	5019	16	20
·5661	5580	5500	5422	5345	5269	5195	5122	5050	·5630	5549	5469	5391	5314	5238	5164	5091	5019	17	22
·5660	5579	5499	5421	5344	5268	5194	5121	5049	·5629	5548	5468	5390	5313	5237	5163	5090	5018	18	23
·5660	5579	5499	5421	5344	5268	5194	5121	5049	·5629	5548	5468	5390	5313	5237	5163	5090	5018	19	24
·5659	5578	5498	5420	5343	5267	5193	5120	5048	·5628	5547	5467	5389	5312	5236	5162	5089	5017	20	25
·5659	5578	5498	5420	5343	5267	5193	5120	5048	·5628	5547	5467	5389	5312	5236	5162	5089	5017	21	27
·5658	5577	5497	5419	5342	5266	5192	5119	5047	·5627	5546	5466	5388	5311	5235	5161	5088	5016	22	28
·5658	5577	5497	5419	5342	5266	5192	5119	5047	·5627	5546	5466	5388	5311	5236	5161	5088	5016	23	29
·5657	5576	5496	5418	5341	5265	5191	5118	5046	·5626	5545	5465	5387	5310	5234	5160	5087	5015	24	30
·5656	5575	5495	5417	5340	5264	5190	5117	5045	·5626	5545	5465	5387	5310	5234	5160	5087	5015	25	32
·5656	5575	5495	5417	5340	5264	5190	5117	5045	·5625	5544	5464	5386	5309	5233	5159	5086	5014	26	33
·5655	5574	5494	5416	5339	5263	5189	5116	5044	·5625	5544	5464	5386	5309	5233	5159	5086	5014	27	34
·5655	5574	5494	5416	5339	5263	5189	5116	5044	·5624	5543	5463	5385	5308	5232	5158	5085	5013	28	35
·5654	5573	5493	5415	5338	5262	5188	5115	5043	·5624	5543	5463	5385	5308	5232	5158	5085	5013	29	37
·5654	5573	5493	5415	5338	5262	5188	5115	5043	·5623	5542	5462	5384	5307	5231	5157	5084	5012	30	38
·5653	5572	5492	5414	5337	5261	5187	5114	5042	·5623	5542	5462	5384	5307	5231	5157	5084	5012	31	39
·5653	5572	5492	5414	5337	5261	5187	5114	5042	·5622	5541	5461	5383	5306	5230	5156	5083	5011	32	41
·5652	5571	5491	5413	5336	5260	5186	5113	5041	·5622	5541	5461	5383	5306	5230	5156	5083	5011	33	42
·5652	5571	5491	5413	5336	5260	5186	5113	5041	·5621	5540	5460	5382	5305	5229	5155	5082	5010	34	43
·5651	5570	5490	5412	5335	5259	5185	5112	5040	·5621	5540	5460	5382	5305	5229	5155	5082	5010	35	44
·5651	5570	5490	5412	5335	5259	5185	5112	5040	·5620	5539	5459	5381	5304	5228	5154	5081	5009	36	45
·5650	5569	5489	5411	5334	5258	5184	5111	5039	·5620	5539	5459	5381	5304	5228	5154	5081	5009	37	47
·5650	5569	5489	5411	5334	5258	5184	5111	5039	·5619	5538	5458	5380	5303	5227	5153	5080	5008	38	48
·5649	5568	5488	5410	5333	5257	5183	5110	5038	·5619	5538	5458	5380	5303	5227	5153	5080	5008	39	49
·5649	5568	5488	5410	5333	5257	5183	5110	5038	·5618	5537	5457	5379	5302	5226	5152	5079	5007	40	51
·5648	5567	5487	5409	5332	5256	5182	5109	5037	·5618	5537	5457	5379	5302	5226	5152	5079	5007	41	52
·5648	5567	5487	5409	5332	5256	5182	5109	5037	·5617	5536	5456	5378	5301	5225	5151	5078	5006	42	53
·5647	5566	5486	5408	5331	5255	5181	5108	5036	·5617	5536	5456	5378	5301	5225	5151	5078	5006	43	54
·5647	5566	5486	5408	5331	5255	5181	5108	5036	·5616	5535	5455	5377	5300	5224	5150	5077	5005	44	56
·5646	5565	5485	5407	5330	5254	5180	5107	5035	·5616	5535	5455	5377	5300	5224	5150	5077	5005	45	57
·5646	5565	5485	5407	5330	5254	5180	5107	5035	·5615	5534	5454	5376	5299	5223	5149	5076	5004	46	58
·5645	5564	5484	5406	5329	5253	5179	5106	5034	·5615	5534	5454	5376	5299	5223	5149	5076	5004	47	59
·5644	5563	5483	5405	5328	5252	5178	5105	5033	·5614	5533	5453	5375	5298	5222	5148	5075	5003	48	61
·5644	5563	5483	5405	5328	5252	5178	5105	5033	·5614	5533	5453	5375	5298	5222	5148	5075	5003	49	62
·5643	5562	5482	5404	5327	5251	5177	5104	5032	·5613	5532	5452	5374	5297	5221	5147	5074	5002	50	63
·5643	5562	5482	5404	5327	5251	5177	5104	5032	·5613	5532	5452	5374	5297	5221	5147	5074	5002	51	64
·5642	5561	5481	5403	5326	5250	5176	5103	5031	·5612	5531	5451	5373	5296	5220	5146	5073	5001	52	66
·5642	5561	5481	5403	5326	5250	5176	5103	5031	·5612	5531	5451	5373	5296	5220	5146	5073	5001	53	67
·5641	5560	5480	5402	5325	5249	5175	5102	5030	·5611	5530	5450	5372	5295	5219	5145	5072	5000	54	68
·5641	5560	5480	5402	5325	5249	5175	5102	5030	·5611	5530	5450	5372	5295	5219	5145	5072	5000	55	69
·5640	5559	5479	5401	5324	5248	5174	5101	5029	·5610	5529	5449	5371	5294	5218	5144	5071	4999	56	71
·5640	5559	5479	5401	5324	5248	5174	5101	5029	·5610	5529	5449	5371	5294	5218	5144	5071	4999	57	72
·5639	5558	5478	5400	5323	5247	5173	5100	5028	·5609	5528	5448	5370	5293	5217	5143	5070	4998	58	73
·5639	5558	5478	5400	5323	5247	5173	5100	5028	·5609	5528	5448	5370	5293	5217	5143	5070	4998	59	74
53′	54′	55′	56′	57′	58′	59′	60′	61′	53′	54′	55′	56′	57′	58′	59′	60′	61′		

TABLE 34

Logarithms of the Apparent Altitudes and Horizontal Parallax.

′	Apparent Altitude 69°									Apparent Altitude 70°									″ or ′	P. to ″ of Pa.
	Moon's Horizontal Parallax.									Moon's Horizontal Parallax.										
	53′	54′	55′	56′	57′	58′	59′	60′	61′	53′	54′	55′	56′	57′	58′	59′	60′	61′		
0	0·5608	5527	5447	5369	5292	5216	5142	5069	4997	0·5580	5499	5419	5341	5264	5188	5114	5041	4969	0	0
1	·5608	5527	5447	5369	5292	5216	5142	5069	4997	·5580	5499	5419	5341	5264	5188	5114	5041	4969	1	1
2	·5608	5527	5447	5369	5292	5216	5142	5069	4997	·5579	5498	5418	5340	5263	5187	5113	5040	4968	2	3
3	·5607	5526	5446	5368	5291	5215	5141	5068	4996	·5579	5498	5418	5340	5263	5187	5113	5040	4968	3	4
4	·5607	5526	5446	5368	5291	5215	5141	5068	4996	·5578	5497	5417	5339	5262	5186	5112	5039	4967	4	5
5	·5606	5525	5445	5367	5290	5214	5140	5067	4995	·5578	5497	5417	5339	5262	5186	5112	5039	4967	5	6
6	·5606	5525	5445	5367	5290	5214	5140	5067	4995	·5577	5496	5416	5338	5261	5185	5111	5038	4966	6	8
7	·5605	5524	5444	5366	5289	5213	5139	5066	4994	·5577	5496	5416	5338	5261	5185	5111	5038	4966	7	9
8	·5605	5524	5444	5366	5289	5213	5139	5066	4994	·5576	5495	5415	5337	5260	5184	5110	5037	4965	8	10
9	·5604	5523	5443	5365	5288	5212	5138	5065	4993	·5576	5495	5415	5337	5260	5184	5110	5037	4965	9	11
10	·5604	5523	5443	5365	5288	5212	5138	5065	4993	·5576	5495	5415	5337	5260	5184	5110	5037	4965	10	13
11	·5603	5522	5442	5364	5287	5211	5137	5064	4992	·5575	5494	5414	5336	5259	5183	5109	5036	4964	11	14
12	·5603	5522	5442	5364	5287	5211	5137	5064	4992	·5575	5494	5414	5336	5259	5183	5109	5036	4964	12	15
13	·5602	5521	5441	5363	5286	5210	5136	5063	4991	·5574	5493	5413	5335	5258	5182	5108	5035	4963	13	17
14	·5602	5521	5441	5363	5286	5210	5136	5063	4991	·5574	5493	5413	5335	5258	5182	5108	5035	4963	14	18
15	·5601	5520	5440	5362	5285	5209	5135	5062	4990	·5573	5492	5412	5334	5257	5181	5107	5034	4962	15	19
16	·5601	5520	5440	5362	5285	5209	5135	5062	4990	·5573	5492	5412	5334	5257	5181	5107	5034	4962	16	20
17	·5600	5519	5439	5361	5284	5208	5134	5061	4989	·5572	5491	5411	5333	5256	5180	5106	5033	4961	17	22
18	·5600	5519	5439	5361	5284	5208	5134	5061	4989	·5572	5491	5411	5333	5256	5180	5106	5033	4961	18	23
19	·5599	5518	5438	5360	5283	5207	5133	5060	4988	·5571	5490	5410	5332	5255	5179	5105	5032	4960	19	24
20	·5599	5518	5438	5360	5283	5207	5133	5060	4988	·5571	5490	5410	5332	5255	5179	5105	5032	4960	20	25
21	·5598	5517	5437	5359	5282	5206	5132	5059	4987	·5571	5490	5410	5332	5255	5179	5105	5032	4960	21	27
22	·5598	5517	5437	5359	5282	5206	5132	5059	4987	·5570	5489	5409	5331	5254	5178	5104	5031	4959	22	28
23	·5597	5516	5436	5358	5281	5205	5131	5058	4986	·5570	5489	5409	5331	5254	5178	5104	5031	4959	23	29
24	·5597	5516	5436	5358	5281	5205	5131	5058	4986	·5569	5188	5408	5330	5253	5177	5103	5030	4958	24	30
25	·5596	5515	5435	5357	5280	5204	5130	5057	4985	·5569	5488	5408	5330	5253	5177	5103	5030	4958	25	32
26	·5596	5515	5435	5357	5280	5204	5130	5057	4985	·5568	5487	5407	5329	5252	5176	5102	5029	4957	26	33
27	·5596	5515	5435	5357	5280	5204	5130	5057	4985	·5568	5487	5407	5329	5252	5176	5102	5029	4957	27	34
28	·5595	5514	5434	5356	5279	5203	5129	5056	4984	·5567	5486	5406	5328	5251	5175	5101	5028	4956	28	35
29	·5595	5514	5434	5356	5279	5203	5129	5056	4984	·5567	5486	5406	5328	5251	5175	5101	5028	4956	29	37
30	·5594	5513	5433	5355	5278	5202	5128	5055	4983	·5567	5486	5406	5328	5251	5175	5101	5028	4956	30	38
31	·5594	5513	5433	5355	5278	5202	5128	5055	4983	·5566	5485	5405	5327	5250	5174	5100	5027	4955	31	39
32	·5593	5512	5432	5354	5277	5201	5127	5054	4982	·5566	5485	5405	5327	5250	5174	5100	5027	4955	32	41
33	·5593	5512	5432	5354	5277	5201	5127	5054	4982	·5565	5484	5404	5326	5249	5173	5099	5026	4954	33	42
34	·5592	5511	5431	5353	5276	5200	5126	5053	4981	·5565	5484	5404	5326	5249	5173	5099	5026	4954	34	43
35	·5592	5511	5431	5353	5276	5200	5126	5053	4981	·5564	5483	5403	5325	5248	5172	5098	5025	4953	35	44
36	·5591	5510	5430	5352	5275	5199	5125	5052	4980	·5564	5483	5403	5325	5248	5172	5098	5025	4953	36	45
37	·5591	5510	5430	5352	5275	5199	5125	5052	4980	·5563	5482	5402	5324	5247	5171	5097	5024	4952	37	47
38	·5590	5509	5429	5351	5274	5198	5124	5051	4979	·5563	5482	5402	5324	5247	5171	5097	5024	4952	38	48
39	·5590	5509	5429	5351	5274	5198	5124	5051	4979	·5563	5482	5402	5324	5247	5171	5097	5024	4952	39	49
40	·5589	5508	5428	5350	5273	5197	5123	5050	4978	·5562	5481	5401	5323	5246	5170	5096	5023	4951	40	51
41	·5589	5508	5428	5350	5273	5197	5123	5050	4978	·5562	5481	5401	5323	5246	5170	5096	5023	4951	41	52
42	·5588	5507	5427	5349	5272	5196	5122	5049	4977	·5561	5480	5400	5322	5245	5169	5095	5022	4950	42	53
43	·5588	5507	5427	5349	5272	5196	5122	5049	4977	·5561	5480	5400	5322	5245	5169	5095	5022	4950	43	54
44	·5588	5507	5427	5349	5272	5196	5122	5049	4977	·5560	5479	5399	5321	5244	5168	5094	5021	4949	44	56
45	·5587	5506	5426	5348	5271	5195	5121	5048	4976	·5560	5479	5399	5321	5244	5168	5094	5021	4949	45	57
46	·5587	5506	5426	5348	5271	5195	5121	5048	4976	·5559	5478	5398	5320	5243	5167	5093	5020	4948	46	58
47	·5586	5505	5425	5347	5270	5194	5120	5047	4975	·5559	5478	5398	5320	5243	5167	5093	5020	4948	47	59
48	·5586	5505	5425	5347	5270	5194	5120	5047	4975	·5559	5478	5398	5320	5243	5167	5093	5020	4948	48	61
49	·5585	5504	5424	5346	5269	5193	5119	5046	4974	·5558	5477	5397	5319	5242	5166	5092	5019	4947	49	62
50	·5585	5504	5424	5346	5269	5193	5119	5046	4974	·5558	5477	5397	5319	5242	5166	5092	5019	4947	50	63
51	·5584	5503	5423	5345	5268	5192	5118	5045	4973	·5557	5476	5396	5318	5241	5165	5091	5018	4946	51	64
52	·5584	5503	5423	5345	5268	5192	5118	5045	4973	·5557	5476	5396	5318	5241	5165	5091	5018	4946	52	66
53	·5583	5502	5422	5344	5267	5191	5117	5044	4972	·5556	5475	5395	5317	5240	5164	5090	5017	4945	53	67
54	·5583	5502	5422	5344	5267	5191	5117	5044	4972	·5556	5475	5395	5317	5240	5164	5090	5017	4945	54	68
55	·5582	5501	5421	5343	5266	5190	5116	5043	4971	·5555	5474	5394	5316	5239	5163	5089	5016	4944	55	69
56	·5582	5501	5421	5343	5266	5190	5116	5043	4971	·5555	5474	5394	5316	5239	5163	5089	5016	4944	56	71
57	·5582	5501	5421	5343	5266	5190	5116	5043	4971	·5555	5474	5394	5316	5239	5163	5089	5016	4944	57	72
58	·5581	5500	5420	5342	5265	5189	5115	5042	4970	·5554	5473	5393	5315	5238	5162	5088	5015	4943	58	73
59	·5581	5500	5420	5342	5265	5189	5115	5042	4970	·5554	5473	5393	5315	5238	5162	5088	5015	4943	59	74
	53′	54′	55′	56′	57′	58′	59′	60′	61′	53′	54′	55′	56′	57′	58′	59′	60′	61′		

TABLE 34

Logarithms of the Apparent Altitudes and Horizontal Parallax.

Apparent Altitude 71°									Apparent Altitude 72°									' or "	P.P. to " of Par.
Moon's Horizontal Parallax.									Moon's Horizontal Parallax.										
53′	54′	55′	56′	57′	58′	59′	60′	61′	53′	54′	55′	56′	57′	58′	59′	60′	61′		
0 ·5553	5472	5392	5314	5237	5161	5087	5014	4942	0 ·5528	5447	5367	5289	5212	5136	5062	4989	4917	0	—0
·5553	5472	5392	5314	5237	5161	5087	5014	4942	·5528	5447	5367	5289	5212	5136	5062	4989	4917	1	1
·5552	5471	5391	5313	5236	5160	5086	5013	4941	·5527	5446	5366	5288	5211	5135	5061	4988	4916	2	3
·5552	5471	5391	5313	5236	5160	5086	5013	4941	·5527	5446	5366	5288	5211	5135	5061	4988	4916	3	4
·5552	5471	5391	5313	5236	5160	5086	5013	4941	·5526	5445	5365	5287	5210	5134	5060	4987	4915	4	5
·5551	5470	5390	5312	5235	5159	5085	5012	4940	·5526	5445	5365	5287	5210	5134	5060	4987	4915	5	6
·5551	5470	5390	5312	5235	5159	5085	5012	4940	·5525	5444	5364	5286	5209	5133	5059	4986	4914	6	8
·5550	5469	5389	5311	5234	5158	5084	5011	4939	·5525	5444	5364	5286	5209	5133	5059	4986	4914	7	9
·5550	5469	5389	5311	5234	5158	5084	5011	4939	·5525	5444	5364	5286	5209	5133	5059	4986	4914	8	10
·5549	5468	5388	5310	5233	5157	5083	5010	4938	·5524	5443	5363	5285	5208	5132	5058	4985	4913	9	11
·5549	5468	5388	5310	5233	5157	5083	5010	4938	·5524	5443	5363	5285	5208	5132	5058	4985	4913	10	13
·5549	5468	5388	5310	5233	5157	5083	5010	4938	·5523	5442	5362	5284	5207	5131	5057	4984	4912	11	14
·5548	5467	5387	5309	5232	5156	5082	5009	4937	·5523	5442	5362	5284	5207	5131	5057	4984	4912	12	15
·5548	5467	5387	5309	5232	5156	5082	5009	4937	·5523	5442	5362	5284	5207	5131	5057	4984	4912	13	17
·5547	5466	5386	5308	5231	5155	5081	5008	4936	·5522	5441	5361	5283	5206	5130	5056	4983	4911	14	18
·5547	5466	5386	5308	5231	5155	5081	5008	4936	·5522	5441	5361	5283	5206	5130	5056	4983	4911	15	19
5546	5465	5385	5307	5230	5154	5080	5007	4935	·5521	5440	5360	5282	5205	5129	5055	4982	4910	16	20
·5546	5465	5385	5307	5230	5154	5080	5007	4935	·5521	5440	5360	5282	5205	5129	5055	4982	4910	17	22
·5546	5465	5385	5307	5230	5154	5080	5007	4935	·5521	5440	5360	5282	5205	5129	5055	4982	4910	18	23
·5545	5464	5384	5306	5229	5153	5079	5006	4934	·5520	5439	5359	5281	5204	5128	5054	4981	4909	19	24
·5545	5464	5384	5306	5229	5153	5079	5006	4934	·5520	5439	5359	5281	5204	5128	5054	4981	4909	20	25
·5544	5463	5383	5305	5228	5152	5078	5005	4933	·5519	5438	5358	5280	5203	5127	5053	4980	4908	21	27
·5544	5463	5383	5305	5228	5152	5078	5005	4933	·5519	5438	5358	5280	5203	5127	5053	4980	4908	22	28
·5543	5462	5382	5304	5227	5151	5077	5004	4932	·5519	5438	5358	5280	5203	5127	5053	4980	4908	23	29
·5543	5462	5382	5304	5227	5151	5077	5004	4932	·5518	5437	5357	5279	5202	5126	5052	4979	4907	24	30
·5543	5462	5382	5304	5227	5151	5077	5004	4932	·5518	5437	5357	5279	5202	5126	5052	4979	4907	25	32
·5542	5461	5381	5303	5226	5150	5076	5003	4931	·5517	5436	5356	5278	5201	5125	5051	4978	4906	26	33
·5542	5461	5381	5303	5226	5150	5076	5003	4931	·5517	5436	5356	5278	5201	5125	5051	4978	4906	27	34
·5541	5460	5380	5302	5225	5149	5075	5002	4930	·5517	5436	5356	5278	5201	5125	5051	4978	4906	28	35
·5541	5460	5380	5302	5225	5149	5075	5002	4930	·5516	5435	5355	5277	5200	5124	5060	4977	4905	29	37
·5540	5459	5379	5301	5224	5148	5074	5001	4929	·5516	5435	5355	5277	5200	5124	5050	4977	4905	30	38
·5540	5459	5379	5301	5224	5148	5074	5001	4929	·5515	5434	5354	5276	5199	5123	5049	4976	4904	31	39
·5540	5459	5379	5301	5224	5148	5074	5001	4929	·5515	5434	5354	5276	5199	5123	5049	4976	4904	32	41
·5539	5458	5378	5300	5223	5147	5073	5000	4928	·5515	5434	5354	5276	5199	5123	5049	4976	4904	33	42
·5539	5458	5378	5300	5223	5147	5073	5000	4928	·5514	5433	5353	5275	5198	5122	5048	4975	4903	34	43
·5538	5457	5377	5299	5222	5146	5072	4999	4927	·5514	5433	5353	5275	5198	5122	5048	4975	4903	35	44
·5538	5457	5377	5299	5222	5146	5072	4999	4927	·5513	5432	5352	5274	5197	5121	5047	4974	4902	36	45
·5537	5456	5376	5298	5221	5145	5072	4998	4926	·5513	5432	5352	5274	5197	5121	5047	4974	4902	37	47
·5537	5456	5376	5298	5221	5145	5071	4998	4926	·5513	5432	5352	5274	5197	5121	5047	4974	4902	38	48
·5537	5456	5376	5298	5221	5145	5071	4998	4926	·5512	5431	5351	5273	5196	5120	5046	4973	4901	39	49
·5536	5455	5375	5297	5220	5144	5070	4997	4925	·5512	5431	5351	5273	5196	5120	5046	4973	4901	40	51
·5536	5455	5375	5297	5220	5144	5070	4997	4925	·5511	5430	5350	5272	5195	5119	5045	4972	4900	41	52
·5535	5454	5374	5296	5219	5143	5069	4996	4924	·5511	5430	5350	5272	5195	5119	5045	4972	4900	42	53
·5535	5454	5374	5296	5219	5143	5069	4996	4924	·5511	5430	5350	5272	5195	5119	5045	4972	4900	43	54
·5535	5454	5374	5296	5219	5143	5069	4996	4924	·5510	5429	5349	5271	5194	5118	5044	4971	4899	44	56
·5534	5453	5373	5295	5218	5142	5068	4995	4923	·5510	5429	5349	5271	5194	5118	5044	4971	4899	45	57
·5534	5453	5373	5295	5218	5142	5068	4995	4923	·5509	5428	5348	5270	5193	5117	5043	4970	4898	46	58
·5533	5452	5372	5294	5217	5141	5067	4994	4922	·5509	5428	5348	5270	5193	5117	5043	4970	4898	47	59
·5533	5452	5372	5294	5217	5141	5067	4994	4922	·5509	5428	5348	5270	5193	5117	5043	4970	4898	48	61
·5532	5451	5371	5293	5216	5140	5066	4993	4921	·5508	5427	5347	5269	5192	5116	5042	4969	4897	49	62
·5532	5451	5371	5293	5216	5140	5066	4993	4921	·5508	5427	5347	5269	5192	5116	5042	4969	4897	50	63
·5532	5451	5371	5293	5216	5140	5066	4993	4921	·5508	5427	5347	5269	5192	5116	5042	4969	4897	51	64
·5531	5450	5370	5292	5215	5139	5065	4992	4920	·5507	5426	5346	5268	5191	5115	5041	4968	4896	52	66
·5531	5450	5370	5292	5215	5139	5065	4992	4920	·5507	5426	5346	5268	5191	5115	5041	4968	4896	53	67
·5530	5449	5369	5291	5214	5138	5064	4991	4919	·5506	5425	5345	5267	5190	5114	5040	4967	4896	54	68
·5530	5449	5369	5291	5214	5138	5064	4991	4919	·5506	5425	5345	5267	5190	5114	5040	4967	4895	55	69
·5530	5449	5369	5291	5214	5138	5064	4991	4919	·5506	5425	5345	5267	5190	5114	5040	4967	4895	56	71
·5529	5448	5368	5290	5213	5137	5063	4990	4918	·5505	5424	5344	5266	5189	5113	5039	4966	4895	57	72
·5529	5448	5368	5290	5213	5137	5063	4990	4918	·5505	5424	5344	5266	5189	5113	5039	4966	4894	58	73
·5528	5447	5367	5289	5212	5136	5062	4989	4917	·5504	5423	5343	5265	5188	5112	5038	4965	4894	59	74
53′	54′	55′	56′	57′	58′	59′	60′	61′	53′	54′	55′	56′	57′	58′	59′	60′	61′		

TABLE 34

Logarithms of the Apparent Altitudes and Horizontal Parallax.

	Apparent Altitude 73°									Apparent Altitude 74°										P.P. in ″ of Par.
	Moon's Horizontal Parallax.									Moon's Horizontal Parallax.									″ or ′	
′	53′	54′	55′	56′	57′	58′	59′	60′	61′	53′	54′	55′	56′	57′	58′	59′	60′	61′		
0	0 ·5504	5423	5343	5265	5188	5112	5038	4965	4893	0 5482	5401	5321	5243	5166	5090	5016	4943	4871	0	—
1	·5504	5423	5343	5265	5188	5112	5038	4965	4893	·5481	5400	5320	5242	5165	5089	5015	4942	4870	1	1
2	·5503	5422	5342	5264	5187	5111	5037	4964	4892	·5481	5400	5320	5242	5165	5089	5015	4942	4870	2	3
3	·5503	5422	5342	5264	5187	5111	5037	4964	4892	·5481	5400	5320	5242	5165	5089	5015	4942	4870	3	4
4	·5502	5421	5341	5263	5186	5110	5036	4963	4891	·5480	5399	5319	5241	5164	5088	5014	4941	4869	4	5
5	·5502	5421	5341	5263	5186	5110	5036	4963	4891	·5480	5399	5319	5241	5164	5088	5014	4941	4869	5	6
6	·5502	5421	5341	5263	5186	5110	5036	4963	4891	·5479	5398	5318	5240	5163	5087	5013	4940	4868	6	8
7	·5501	5420	5340	5262	5185	5109	5035	4962	4890	·5479	5398	5318	5240	5163	5087	5013	4940	4868	7	9
8	·5501	5420	5340	5262	5185	5109	5035	4962	4890	·5479	5398	5318	5240	5163	5087	5013	4940	4868	8	10
9	·5501	5420	5340	5262	5185	5109	5035	4962	4890	·5478	5397	5317	5239	5162	5086	5012	4939	4867	9	11
10	·5500	5419	5339	5261	5184	5108	5034	4961	4889	·5478	5397	5317	5239	5162	5086	5012	4939	4867	10	13
11	·5500	5419	5339	5261	5184	5108	5034	4961	4889	·5478	5397	5317	5239	5162	5086	5012	4939	4867	11	14
12	·5499	5418	5338	5260	5183	5107	5033	4960	4888	·5477	5396	5316	5238	5161	5085	5011	4938	4866	12	15
13	·5499	5418	5338	5260	5183	5107	5033	4960	4888	·5477	5396	5316	5238	5161	5085	5011	4938	4866	13	17
14	·5499	5418	5338	5260	5183	5107	5033	4960	4888	·5477	5396	5316	5238	5161	5085	5011	4938	4866	14	18
15	·5498	5417	5337	5259	5182	5106	5032	4959	4887	·5476	5395	5315	5237	5160	5084	5010	4937	4865	15	19
16	·5498	5417	5337	5259	5182	5106	5032	4959	4887	·5476	5395	5315	5237	5160	5084	5010	4937	4865	16	20
17	·5498	5417	5337	5259	5182	5106	5032	4959	4887	·5475	5394	5314	5236	5159	5083	5009	4936	4864	17	22
18	·5497	5416	5336	5258	5181	5105	5031	4958	4886	·5475	5394	5314	5236	5159	5083	5009	4936	4864	18	23
19	·5497	5416	5336	5258	5181	5105	5031	4958	4886	·5475	5394	5314	5236	5159	5083	5009	4936	4864	19	24
20	·5496	5415	5335	5257	5180	5104	5030	4957	4885	·5474	5393	5313	5235	5158	5082	5008	4935	4863	20	25
21	·5496	5415	5335	5257	5180	5104	5030	4957	4885	·5474	5393	5313	5235	5158	5082	5008	4935	4863	21	27
22	·5496	5415	5335	5257	5180	5104	5030	4957	4885	·5474	5393	5313	5235	5158	5082	5008	4935	4863	22	28
23	·5495	5414	5334	5256	5179	5103	5029	4956	4884	·5473	5392	5312	5234	5157	5081	5007	4934	4862	23	29
24	·5495	5414	5334	5256	5179	5103	5029	4956	4884	·5473	5392	5312	5234	5157	5081	5007	4934	4862	24	30
25	·5495	5414	5334	5256	5179	5103	5029	4956	4884	·5473	5392	5312	5234	5157	5081	5007	4934	4862	25	32
26	·5494	5413	5333	5255	5178	5102	5028	4955	4883	·5472	5391	5311	5233	5156	5080	5006	4933	4861	26	33
27	·5494	5413	5333	5255	5178	5102	5028	4955	4883	·5472	5391	5311	5233	5156	5080	5006	4933	4861	27	34
28	·5494	5413	5333	5255	5178	5102	5028	4955	4883	·5472	5391	5311	5233	5156	5080	5006	4933	4861	28	35
29	·5493	5412	5332	5254	5177	5101	5027	4954	4882	·5471	5390	5310	5232	5155	5079	5005	4932	4860	29	37
30	·5493	5412	5332	5254	5177	5101	5027	4954	4882	·5471	5390	5310	5232	5155	5079	5005	4932	4860	30	38
31	·5492	5411	5331	5253	5176	5100	5026	4953	4881	·5471	5390	5310	5232	5155	5079	5005	4932	4860	31	39
32	·5492	5411	5331	5253	5176	5100	5026	4953	4881	·5470	5389	5309	5231	5154	5078	5004	4931	4859	32	41
33	·5492	5411	5331	5253	5176	5100	5026	4953	4881	·5470	5389	5309	5231	5154	5078	5004	4931	4859	33	42
34	·5491	5410	5330	5252	5175	5099	5025	4952	4880	·5470	5389	5309	5231	5154	5078	5004	4931	4859	34	43
35	·5491	5410	5330	5252	5175	5099	5025	4952	4880	·5469	5388	5308	5230	5153	5077	5003	4930	4858	35	44
36	·5490	5409	5329	5251	5174	5098	5024	4951	4879	·5469	5388	5308	5230	5153	5077	5003	4930	4858	36	45
37	·5490	5409	5329	5251	5174	5098	5024	4951	4879	·5468	5387	5307	5229	5152	5076	5002	4929	4857	37	47
38	·5490	5409	5329	5251	5174	5098	5024	4951	4879	·5468	5387	5307	5229	5152	5076	5002	4929	4857	38	48
39	·5489	5408	5328	5250	5173	5097	5023	4950	4878	·5468	5387	5307	5229	5152	5076	5002	4929	4857	39	49
40	·5489	5408	5328	5250	5173	5097	5023	4950	4878	·5467	5386	5306	5228	5151	5075	5001	4928	4856	40	51
41	·5489	5408	5328	5250	5173	5097	5023	4950	4878	·5467	5386	5306	5228	5151	5075	5001	4928	4856	41	52
42	·5488	5407	5327	5249	5172	5096	5022	4949	4877	·5467	5386	5306	5228	5151	5075	5001	4928	4856	42	53
43	·5488	5407	5327	5249	5172	5096	5022	4949	4877	·5466	5385	5305	5227	5150	5074	5000	4927	4855	43	54
44	·5487	5406	5326	5248	5171	5095	5021	4948	4876	·5466	5385	5305	5227	5150	5074	5000	4927	4855	44	56
45	·5487	5406	5326	5248	5171	5095	5021	4948	4876	·5466	5385	5305	5227	5150	5074	5000	4927	4855	45	57
46	·5487	5406	5326	5248	5171	5095	5021	4948	4876	·5465	5384	5304	5226	5149	5073	4999	4926	4854	46	58
47	·5486	5405	5325	5247	5170	5094	5020	4947	4875	·5465	5384	5304	5226	5149	5073	4999	4926	4854	47	59
48	·5486	5405	5325	5247	5170	5094	5020	4947	4875	·5465	5384	5304	5226	5149	5073	4999	4926	4854	48	61
49	·5486	5405	5325	5247	5170	5094	5020	4947	4875	·5464	5383	5303	5225	5148	5072	4998	4925	4853	49	62
50	·5485	5404	5324	5246	5169	5093	5019	4946	4874	·5464	5383	5303	5225	5148	5072	4998	4925	4853	50	63
51	·5485	5404	5324	5246	5169	5093	5019	4946	4874	·5464	5383	5303	5225	5148	5072	4998	4925	4853	51	64
52	·5484	5403	5323	5245	5168	5092	5018	4945	4873	·5463	5382	5302	5224	5147	5071	4997	4924	4852	52	66
53	·5484	5403	5323	5245	5168	5092	5018	4945	4873	·5463	5382	5302	5224	5147	5071	4997	4924	4852	53	67
54	·5484	5403	5323	5245	5168	5092	5018	4945	4873	·5463	5382	5302	5224	5147	5071	4997	4924	4852	54	68
55	·5483	5402	5322	5244	5167	5091	5017	4944	4872	·5462	5381	5301	5223	5146	5070	4996	4923	4851	55	69
56	·5483	5402	5322	5244	5167	5091	5017	4944	4872	·5462	5381	5301	5223	5146	5070	4996	4923	4851	56	71
57	·5483	5402	5322	5244	5167	5091	5017	4944	4872	·5462	5381	5301	8223	5146	5070	4996	4923	4851	57	72
58	·5482	5401	5321	5243	5166	5090	5016	4943	4871	·5461	5380	5300	5222	5145	5069	4995	4922	4850	58	73
59	·5482	5401	5321	5243	5166	5090	5016	4943	4871	·5461	5380	5300	5222	5145	5069	4995	4922	4850	59	74
	53′	54′	55′	56′	57′	58′	59′	60′	61′	53′	54′	55′	56′	57′	58′	59′	60′	61′		

TABLE 34

Logarithms of the Apparent Altitudes and Horizontal Parallax.

′	Apparent Altitude 75°									Apparent Altitude 76°									′ or ″	P.P. to ″ of Par.
	Moon's Horizontal Parallax.									Moon's Horizontal Parallax.										
	53′	54′	55′	56′	57′	58′	59′	60′	61′	53′	54′	55′	56′	57′	58′	59′	60′	61′		
0	0·5461	5380	5300	5222	5145	5069	4995	4922	4850	0·5441	5360	5280	5202	5125	5049	4975	4902	4830	0	—0
1	·5460	5379	5299	5221	5144	5068	4994	4921	4849	·5441	5360	5280	5202	5125	5048	4975	4902	4830	1	1
2	·5460	5379	5299	5221	5144	5068	4994	4921	4849	·5440	5359	5279	5201	5124	5048	4974	4901	4829	2	3
3	·5460	5379	5299	5221	5144	5068	4994	4921	4849	·5440	5359	5279	5201	5124	5048	4974	4901	4829	3	4
4	·5459	5378	5298	5220	5143	5067	4993	4920	4848	·5440	5359	5279	5201	5124	5048	4974	4901	4829	4	5
5	·5459	5378	5298	5220	5143	5067	4993	4920	4848	·5439	5358	5278	5200	5123	5047	4973	4900	4828	5	6
6	·5459	5378	5298	5220	5143	5067	4993	4920	4848	·5439	5358	5278	5200	5123	5047	4973	4900	4828	6	8
7	·5458	5377	5297	5219	5142	5066	4992	4919	4847	·5439	5358	5278	5200	5123	5047	4973	4900	4828	7	9
8	·5458	5377	5297	5219	5142	5066	4992	4919	4847	·5438	5357	5277	5199	5122	5046	4972	4899	4827	8	10
9	·5458	5377	5297	5219	5142	5066	4992	4919	4847	·5438	5357	5277	5199	5122	5046	4972	4899	4827	9	11
10	·5457	5376	5296	5218	5141	5065	4991	4918	4846	·5438	5357	5277	5199	5122	5046	4972	4899	4827	10	13
11	·5457	5376	5296	5218	5141	5065	4991	4918	4846	·5438	5357	5277	5199	5122	5046	4972	4899	4827	11	14
12	·5457	5376	5296	5218	5141	5065	4991	4918	4846	·5437	5356	5276	5198	5121	5045	4971	4898	4826	12	15
13	·5456	5375	5295	5217	5140	5064	4990	4917	4845	·5437	5356	5276	5198	5121	5045	4971	4898	4826	13	17
14	·5456	5375	5295	5217	5140	5064	4990	4917	4845	·5437	5356	5276	5198	5121	5045	4971	4898	4826	14	18
15	·5456	5373	5295	5217	5140	5064	4990	4917	4845	·5436	5355	5275	5197	5120	5044	4970	4897	4825	15	19
16	·5455	5374	5294	5216	5139	5063	4989	4916	4844	·5436	5355	5275	5197	5120	5044	4970	4897	4825	16	20
17	·5455	5374	5294	5216	5139	5063	4989	4916	4844	·5436	5355	5275	5197	5120	5044	4970	4897	4825	17	22
18	·5455	5374	5294	5216	5139	5063	4989	4916	4844	·5435	5354	5274	5196	5119	5043	4969	4896	4824	18	23
19	·5454	5373	5293	5215	5138	5062	4988	4915	4843	·5435	5354	5274	5196	5119	5043	4969	4896	4824	19	24
20	·5454	5373	5293	5215	5138	5062	4988	4915	4843	·5435	5354	5274	5196	5119	5043	4969	4896	4824	20	25
21	·5454	5373	5293	5215	5138	5062	4988	4915	4843	·5434	5353	5273	5195	5118	5042	4968	4895	4823	21	27
22	·5453	5372	5292	5214	5137	5061	4987	4914	4842	·5434	5353	5273	5195	5118	5042	4968	4895	4823	22	28
23	·5453	5372	5292	5214	5137	5061	4987	4914	4842	·5434	5353	5273	5195	5118	5042	4968	4895	4823	23	29
24	·5453	5372	5292	5214	5137	5061	4987	4914	4842	·5434	5353	5273	5195	5118	5042	4968	4895	4823	24	30
25	·5452	5371	5291	5213	5136	5060	4986	4913	4841	·5433	5352	5272	5194	5117	5041	4967	4894	4822	25	32
26	·5452	5371	5291	5213	5136	5060	4986	4913	4841	·5433	5352	5272	5194	5117	5041	4967	4894	4822	26	33
27	·5452	5371	5291	5213	5136	5060	4986	4913	4841	·5433	5352	5272	5194	5117	5041	4967	4894	4822	27	34
28	·5451	5370	5290	5212	5135	5059	4985	4912	4840	·5432	5351	5271	5193	5116	5040	4966	4893	4821	28	35
29	·5451	5370	5290	5212	5135	5059	4985	4912	4840	·5432	5351	5271	5193	5116	5040	4966	4893	4821	29	37
30	·5451	5370	5290	5212	5135	5059	4985	4912	4840	·5432	5351	5271	5193	5116	5040	4966	4893	4821	30	38
31	·5450	5369	5289	5211	5134	5058	4984	4911	4839	·5431	5350	5270	5192	5115	5039	4965	4892	4820	31	39
32	·5450	5369	5289	5211	5134	5058	4984	4911	4839	·5431	5350	5270	5162	5115	5039	4965	4892	4820	32	41
33	·5450	5369	5289	5211	5134	5058	4984	4911	4839	·5431	5350	5270	5192	5115	5039	4965	4892	4820	33	42
34	·5449	5368	5288	5210	5133	5057	4983	4910	4838	·5430	5349	5269	5191	5114	5038	4964	4891	4819	34	43
35	·5449	5368	5288	5210	5133	5057	4983	4910	4838	·5430	5349	5269	5191	5114	5038	4964	4891	4819	35	44
36	·5449	5368	5288	5210	5133	5057	4983	4910	4838	·5430	5349	5269	5191	5114	5038	4664	4891	4819	36	45
37	·5448	5367	5287	5209	5132	5056	4982	4909	4837	·5430	5349	5269	5191	5114	5038	4964	4891	4819	37	47
38	·5448	5367	5287	5209	5132	5056	4982	4909	4837	·5429	5348	5268	5190	5113	5037	4963	4890	4818	38	48
39	·5448	5367	5287	5209	5132	5056	4982	4909	4837	·5429	5348	5268	5190	5113	5037	4964	4890	4818	39	49
40	·5447	5366	5286	5208	5131	5055	4981	4908	4836	·5429	5348	5268	5190	5113	5037	4963	4890	4818	40	51
41	·5447	5366	5286	5208	5131	5055	4981	4908	4836	·5428	5347	5267	5189	5112	5036	4962	4889	4817	41	52
42	·5447	5366	5286	5208	5131	5055	4981	4908	4836	·5428	5347	5267	5189	5112	5036	4962	4889	4817	42	53
43	·5446	5365	5285	5207	5130	5054	4980	4907	4835	·5428	5347	5267	5189	5112	5036	4962	4889	4817	43	54
44	·5446	5365	5285	5207	5130	5054	4980	4907	4835	·5427	5346	5266	5188	5111	5035	4961	4888	4817	44	56
45	·5446	5365	5285	5207	5130	5054	4980	4907	4835	·5427	5346	5266	5188	5111	5035	4961	4888	4816	45	57
46	·5445	5364	5284	5206	5129	5053	4979	4906	4834	·5427	5346	5266	5188	5111	5035	4961	4888	4816	46	58
47	·5445	5364	5284	5206	5129	5053	4979	4906	4834	·5427	5346	5266	5188	5111	5035	4961	4888	4816	47	59
48	·5445	5364	5284	5206	5129	5053	4979	4906	4834	·5426	5345	5265	5187	5110	5034	4960	4887	4815	48	61
49	·5444	5363	5283	5205	5128	5052	4978	4905	4833	·5426	5345	5265	5187	5110	5034	4960	4887	4815	49	62
50	·5444	5363	5283	5205	5128	5052	4978	4905	4833	·5426	5845	5265	5187	5110	5034	4960	4887	4815	50	63
51	·5444	5363	5283	5205	5128	5052	4978	4905	4833	·5425	5344	3264	5186	5109	5033	4959	4886	4814	51	64
52	·5443	5362	5282	5204	5127	5051	4977	4904	4832	·5425	5344	5264	5186	5109	5033	4959	4886	4814	52	66
53	·5443	5362	5282	5204	5127	5051	4977	4904	4832	·5425	5344	5264	5186	5109	5033	4959	4886	4814	53	67
54	·5443	5362	5282	5204	5127	5051	4977	4904	4832	·5425	5344	5264	5186	5109	5033	4959	4886	4814	54	68
55	·5443	5362	5282	5204	5127	5051	4977	4904	4832	·5424	5343	5263	5185	5108	5032	4958	4885	4813	55	69
56	·5442	5361	5281	5203	5126	5050	4976	4903	4831	·5424	5343	5263	5185	5108	5032	4658	4885	4813	56	71
57	·5442	5361	5281	5203	5126	5050	4976	4903	4831	·5424	5343	5263	5185	5108	5032	4958	4885	4813	57	72
58	·5442	5361	5281	5203	5126	5050	4976	4903	4831	·5423	5342	5262	5184	5107	5031	4967	4884	4812	58	73
59	·5441	5360	5280	5202	5125	5049	4975	4902	4830	·5423	5342	5262	5184	5107	5031	4967	4884	4812	59	74
	53′	54′	55′	56′	57′	58′	59′	60′	61′	53′	54′	55′	56′	57′	58′	59′	60′	61′		

TABLE 34

Logarithms of the Apparent Altitudes and Horizontal Parallax.

	Apparent Altitude 77°									Apparent Altitude 78°										
	Moon's Horizontal Parallax.									Moon's Horizontal Parallax.									′ or ″	P.P. to ″ of Par.
′	53′	54′	55′	56′	57′	58′	59′	60′	61′	53′	54′	55′	56′	57′	58′	59′	60′	61′		
0	0 ·5423	5342	5262	5184	5107	5031	4957	4884	4812	0 ·5406	5325	5245	5167	5090	5014	4940	4867	4795	0	0
1	·5422	5341	5261	5183	5106	5030	4956	4883	4811	·5406	5325	5245	5167	5090	5014	4940	4867	4795	1	1
2	·5422	5341	5261	5183	5106	5030	4956	4883	4811	·5405	5324	5244	5166	5089	5013	4939	4866	4794	2	3
3	·5422	5341	5261	5183	5106	5030	4956	4883	4811	·5405	5324	5244	5166	5089	5013	4939	4866	4794	3	4
4	·5422	5341	5261	5183	5106	5030	4956	4883	4811	·5405	5324	5244	5166	5089	5013	4939	4866	4794	4	5
5	·5421	5340	5260	5182	5105	5029	4955	4882	4810	·5405	5324	5244	5166	5089	5013	4939	4866	4794	5	6
6	·5421	5340	5260	5182	5105	5029	4955	4882	4810	·5404	5323	5243	5165	5088	5012	4938	4865	4793	6	8
7	·5421	5340	5260	5182	5105	5029	4955	4882	4810	·5404	5323	5243	5165	5088	5012	4938	4865	4793	7	9
8	·5420	5339	5259	5181	5104	5028	4954	4881	4809	·5404	5323	5243	5165	5088	5012	4938	4865	4793	8	10
9	·5420	5339	5259	5181	5104	5028	4954	4881	4809	·5404	5323	5243	5165	5088	5012	4938	4865	4793	9	11
10	·5420	5339	5259	5181	5104	5028	4954	4881	4809	·5403	5322	5242	5164	5087	5011	4937	4864	4792	10	13
11	·5420	5339	5259	5181	5104	5028	4954	4881	4809	·5403	5322	5242	5164	5087	5011	4937	4864	4792	11	14
12	·5419	5338	5258	5180	5103	5027	4953	4880	4808	·5403	5322	5242	5164	5087	5011	4937	4864	4792	12	15
13	·5419	5338	5258	5180	5103	5027	4953	4880	4808	·5403	5322	5242	5164	5087	5011	4937	4864	4792	13	17
14	·5419	5338	5258	5180	5103	5027	4953	4880	4808	·5402	5321	5241	5163	5086	5010	4936	4863	4791	14	18
15	·5418	5337	5257	5179	5102	5026	4952	4879	4807	·5402	5321	5241	5163	5086	5010	4936	4863	4791	15	19
16	·5418	5337	5257	5179	5102	5026	4952	4879	4807	·5402	5321	5241	5163	5086	5010	4936	4863	4791	16	20
17	·5418	5337	5257	5179	5102	5026	4952	4879	4807	·5401	5320	5240	5162	5085	5009	4935	4862	4790	17	22
18	·5418	5337	5257	5179	5102	5026	4952	4879	4807	·5401	5320	5240	5162	5085	5009	4935	4862	4790	18	23
19	·5417	5336	5256	5178	5101	5025	4951	4878	4806	·5401	5320	5240	5162	5085	5009	4935	4862	4790	19	24
20	·5417	5336	5256	5178	5101	5025	4951	4878	4806	·5401	5320	5240	5162	5085	5009	4935	4862	4790	20	25
21	·5417	5336	5256	5178	5101	5025	4951	4878	4806	·5400	5319	5239	5161	5084	5008	4934	4861	4789	21	27
22	·5416	5335	5255	5177	5100	5024	4950	4877	4805	·5400	5319	5239	5161	5084	5008	4934	4861	4789	22	28
23	·5416	5335	5255	5177	5100	5024	4950	4877	4805	·5400	5319	5239	5161	5084	5008	4934	4861	4789	23	29
24	·5416	5335	5255	5177	5100	5024	4950	4877	4805	·5400	5319	5239	5161	5084	5008	4934	4861	4789	24	30
25	·5416	5335	5255	5177	5100	5024	4950	4877	4805	·5399	5318	5238	5160	5083	5007	4933	4860	4788	25	32
26	·5415	5334	5254	5176	5099	5023	4949	4876	4804	·5399	5318	5238	5160	5083	5007	4933	4860	4788	26	33
27	·5415	5334	5254	5176	5099	5023	4949	4876	4804	·5399	5318	5238	5160	5083	5007	4933	4860	4788	27	34
28	·5415	5334	5254	5176	5099	5023	4949	4876	4804	·5399	5318	5238	5160	5083	5007	4933	4860	4788	28	35
29	·5415	5334	5254	5176	5099	5023	4949	4876	4804	·5398	5317	5237	5159	5082	5006	4932	4859	4787	29	37
30	·5414	5333	5253	5175	5098	5022	4948	4875	4803	·5398	5317	5237	5159	5082	5006	4932	4859	4787	30	38
31	·5414	5333	5253	5175	5098	5022	4948	4875	4803	·5998	5317	5237	5159	5082	5006	4932	4859	4787	31	39
32	·5414	5333	5253	5175	5098	5022	4948	4875	4803	·5398	5317	5237	5159	5082	5006	4932	4859	4787	32	41
33	·5413	5332	5252	5174	5097	5021	4947	4874	4802	·5397	5316	5236	5158	5081	5005	4931	4858	4786	33	42
34	·5413	5332	5252	5174	5097	5021	4947	4874	4802	·5397	5316	5236	5158	5081	5005	4931	4858	4786	34	43
35	·5413	5332	5252	5174	5097	5021	4947	4874	4802	·5397	5316	5236	5158	5081	5005	4931	4858	4786	35	44
36	·5413	5332	5252	5174	5097	5021	4947	4874	4802	·5397	5316	5236	5158	5081	5005	4931	4858	4786	36	45
37	·5412	5331	5251	5173	5096	5020	4946	4873	4801	·5396	5315	5235	5157	5080	5004	4930	4857	4785	37	47
38	·5412	5331	5251	5173	5096	5020	4946	4873	4801	·5396	5315	5235	5157	5080	5004	4930	4857	4785	38	48
39	·5412	5331	5251	5173	5096	5020	4946	4873	4801	·5396	5315	5235	5157	5080	5004	4930	4857	4785	39	49
40	·5411	5330	5250	5172	5095	5019	4945	4872	4800	·5396	5315	5235	5157	5080	5004	4930	4857	4785	40	51
41	·5411	5330	5250	5172	5095	5019	4945	4872	4800	·5395	5314	5234	5156	5079	5003	4929	4856	4784	41	52
42	·5411	5330	5250	5172	5095	5019	4945	4872	4800	·5395	5314	5234	5156	5079	5003	4929	4856	4784	42	53
43	·5411	5330	5250	5172	5095	5019	4945	4872	4800	·5395	5314	5234	5156	5079	5003	4929	4856	4784	43	54
44	·5410	5329	5249	5171	5094	5018	4944	4871	4799	·5395	5314	5234	5156	5079	5003	4929	4856	4784	44	56
45	·5410	5329	5249	5171	5094	5018	4944	4871	4799	·5394	5313	5233	5155	5078	5002	4928	4855	4783	45	57
46	·5410	5329	5249	5171	5094	5018	4944	4871	4799	·5394	5313	5233	5155	5078	5002	4928	4855	4783	46	58
47	·5409	5328	5248	5170	5093	5017	4943	4870	4798	·5394	5313	5233	5155	5078	5002	4928	4855	4783	47	59
48	·5409	5328	5248	5170	5093	5017	4943	4870	4798	·5394	5313	5233	5155	5078	5002	4928	4855	4783	48	61
49	·5409	5328	5248	5170	5093	5017	4943	4870	4798	·5393	5312	5232	5154	5077	5001	4927	4854	4782	49	62
50	·5409	5328	5248	5170	5093	5017	4943	4870	4798	·5393	5312	5232	5154	5077	5001	4927	4854	4782	50	63
51	·5408	5327	5247	5169	5092	5016	4942	4869	4797	·5393	5312	5232	5154	5077	5001	4927	4854	4782	51	64
52	·5408	5327	5247	5169	5092	5016	4942	4869	4797	·5393	5312	5232	5154	5077	5001	4927	4854	4782	52	66
53	·5408	5327	5247	5169	5092	5016	4942	4869	4797	·5392	5311	5231	5153	5076	5000	4926	4853	4781	53	67
54	·5408	5327	5247	5169	5092	5016	4942	4869	4797	·5392	5311	5231	5153	5076	5000	4926	4853	4781	54	68
55	·5407	5326	5246	5168	5091	5015	4941	4868	4796	·5392	5311	5231	5153	5076	5000	4926	4853	4781	55	69
56	·5407	5326	5246	5168	5091	5015	4941	4868	4796	·5392	5311	5231	5153	5076	5000	4926	4853	4781	56	71
57	·5407	5326	5246	5168	5091	5015	4941	4868	4796	·5391	5310	5230	5152	5075	4999	4925	4852	4780	57	72
58	·5406	5325	5245	5167	5090	5014	4940	4867	4795	·5391	5310	5230	5152	5075	4999	4925	4852	4780	58	73
59	·5406	5325	5245	5167	5090	5014	4940	4867	4795	·5391	5310	5230	5152	5075	4999	4925	4852	4780	59	74
	53′	54′	55′	56′	57′	58′	59′	60′	61′	53′	54′	55′	56′	57′	58′	59′	60′	61′		

TABLE 34

Logarithms of the Apparent Altitudes and Horizontal Parallax.

Apparent Altitude 79°									Apparent Altitude 80°										P.P. to ″ of Par.
Moon's Horizontal Parallax.									Moon's Horizontal Parallax.									′ or ″	
53′	54′	55′	56′	57′	58′	59′	60′	61′	53′	54′	55′	56′	57′	58′	59′	60′	61′		
·5391	5310	5230	5152	5075	4999	4925	4852	4780	0 ·5376	5295	5215	5137	5060	4984	4910	4837	4765	0	—0
·5390	5309	5229	5151	5074	4998	4924	4851	4779	·5376	5295	5215	5137	5060	4984	4910	4837	4765	1	1
·5390	5309	5229	5151	5074	4998	4924	4851	4779	·5376	5295	5215	5137	5060	4984	4910	4837	4765	2	3
·5390	5309	5229	5151	5074	4998	4924	4851	4779	·5376	5295	5215	5137	5060	4984	4910	4837	4765	3	4
·5390	5309	5229	5151	5074	4998	4924	4851	4779	·5376	5295	5215	5137	5060	4984	4910	4837	4765	4	5
·5389	5308	5228	5150	5073	4997	4923	4850	4778	·5375	5294	5214	5136	5059	4983	4909	4836	4764	5	6
·5389	5308	5228	5150	5073	4997	4923	4850	4778	·5375	5294	5214	5136	5059	4983	4909	4836	4764	6	8
·5389	5308	5228	5150	5073	4997	4923	4850	4778	·5375	5294	5214	5136	5059	4983	4909	4836	4764	7	9
·5389	5308	5228	5150	5073	4997	4923	4850	4778	·5375	5294	5214	5136	5059	4983	4909	4836	4764	8	10
·5388	5307	5227	5149	5072	4996	4922	4849	4777	·5375	5293	5213	5135	5058	4982	4909	4835	4763	9	11
·5388	5307	5227	5149	5072	4996	4922	4849	4777	·5374	5293	5213	5135	5058	4982	4908	4835	4763	10	13
·5388	5307	5227	5149	5072	4996	4922	4849	4777	·5374	5293	5213	5135	5058	4982	4908	4835	4763	11	14
·5388	5307	5227	5149	5072	4996	4922	4849	4777	·5374	5293	5213	5135	5058	4982	4908	4835	4763	12	15
·5387	5306	5226	5148	5071	4995	4921	4848	4776	·5374	5293	5213	5135	5058	4982	4908	4835	4763	13	17
·5387	5306	5226	5148	5071	4995	4921	4848	4776	·5373	5292	5212	5134	5057	4981	4907	4834	4762	14	18
·5387	5306	5226	5148	5071	4995	4921	4848	4776	·5373	5292	5212	5134	5057	4981	4907	4834	4762	15	19
·5387	5306	5226	5148	5071	4995	4921	4848	4776	·5373	5292	5212	5134	5057	4981	4907	4834	4762	16	20
·5386	5305	5225	5147	5070	4994	4920	4847	4775	·5373	5292	5212	5134	5057	4981	4907	4834	4762	17	22
·5386	5305	5225	5147	5070	4994	4920	4847	4775	·5373	5292	5212	5134	5057	4981	4907	4834	4762	18	23
·5386	5305	5225	5147	5070	4994	4920	4847	4775	·5372	5291	5211	5133	5056	4980	4906	4833	4761	19	24
·5386	5305	5225	5147	5070	4994	4920	4847	4775	·5372	5291	5211	5133	5056	4980	4906	4833	4761	20	25
·5385	5304	5224	5146	5069	4993	4919	4846	4774	·5372	5291	5211	5133	5056	4980	4906	4833	4761	21	27
·5385	5304	5224	5146	5069	4993	4919	4846	4774	·5372	5291	5211	5133	5056	4980	4906	4833	4761	22	28
·5385	5304	5224	5146	5069	4993	4919	4846	4774	·5371	5290	5210	5132	5055	4979	4905	4832	4760	23	29
·5385	5304	5224	5146	5069	4993	4919	4846	4774	·5371	5290	5210	5132	5055	4979	4905	4832	4760	24	30
·5385	5304	5224	5146	5069	4993	4919	4846	4774	·5371	5290	5210	5132	5055	4979	4905	4832	4760	25	32
·5384	5303	5223	5145	5068	4992	4918	4845	4773	·5371	5290	5210	5132	5055	4979	4905	4832	4760	26	33
·5384	5303	5223	5145	5068	4992	4918	4845	4773	·5371	5290	5210	5132	5055	4979	4905	4832	4760	27	34
·5384	5303	5223	5145	5068	4992	4918	4845	4773	·5370	5289	5209	5131	5054	4978	4904	4831	4759	28	35
·5384	5303	5223	5145	5068	4992	4918	4845	4773	·5370	5289	5209	5131	5054	4978	4904	4831	4759	29	37
·5383	5302	5222	5144	5067	4991	4917	4844	4772	·5370	5289	5209	5131	5054	4978	4904	4831	4759	30	38
·5383	5302	5222	5144	5067	4991	4917	4844	4772	·5370	5289	5209	5131	5054	4978	4904	4831	4759	31	39
·5383	5302	5222	5144	5067	4991	4917	4844	4772	·5370	5289	5209	5131	5054	4978	4904	4831	4759	32	41
·5383	5302	5222	5144	5067	4991	4917	4844	4772	·5369	5288	5208	5130	5053	4977	4903	4830	4758	33	42
·5382	5301	5221	5143	5066	4990	4916	4843	4771	·5369	5288	5208	5130	5053	4977	4903	4830	4758	34	43
·5382	5301	5221	5143	5066	4990	4916	4843	4771	·5369	5288	5208	5130	5053	4977	4903	4830	4758	35	44
·5382	5301	5221	5143	5066	4990	4916	4843	4771	·5369	5288	5208	5130	5053	4977	4903	4830	4758	36	45
·5382	5301	5221	5143	5066	4990	4916	4843	4771	·5368	5287	5207	5129	5052	4976	4902	4829	4757	37	47
·5381	5300	5220	5142	5065	4989	4915	4842	4770	·5368	5287	5207	5129	5052	4976	4902	4829	4757	38	48
·5381	5300	5220	5142	5065	4989	4915	4842	4770	·5368	5287	5207	5129	5052	4976	4902	4829	4757	39	49
·5381	5300	5220	5142	5065	4989	4915	4842	4770	·5368	5287	5207	5129	5052	4976	4902	4829	4757	40	51
·5381	5300	5220	5142	5065	4989	4915	4842	4770	·5368	5287	5207	5129	5052	4976	4902	4829	4757	41	52
·5381	5300	5220	5142	5065	4989	4915	4842	4770	·5367	5286	5206	5128	5051	4975	4901	4828	4756	42	53
·5380	5299	5219	5141	5064	4988	4914	4841	4769	·5367	5286	5206	5128	5051	4975	4901	4828	4756	43	54
·5380	5299	5219	5141	5064	4988	4914	4841	4769	·5367	5286	5206	5128	5051	4975	4901	4828	4756	44	56
·5380	5299	5219	5141	5064	4988	4914	4841	4769	·5367	5286	5206	5128	5051	4975	4901	4828	4756	45	57
·5380	5299	5219	5141	5064	4988	4914	4841	4769	·5367	5286	5206	5128	5051	4975	4901	4828	4756	46	58
·5379	5298	5218	5140	5063	4987	4913	4840	4768	·5366	5285	5205	5127	5050	4974	4900	4827	4755	47	59
·5379	5298	5218	5140	5063	4987	4913	4840	4768	·5366	5285	5205	5127	5050	4974	4900	4827	4755	48	61
·5379	5298	5218	5140	5063	4987	4913	4840	4768	·5366	5285	5205	5127	5050	4974	4900	4827	4755	49	62
·5379	5298	5218	5140	5063	4987	4913	4840	4768	·5366	5285	5205	5127	5050	4974	4900	4827	4755	50	63
·5379	5298	5218	5140	5063	4987	4913	4840	4768	·5366	5285	5205	5127	5050	4974	4900	4827	4755	51	64
·5378	5297	5217	5139	5062	4986	4912	4839	4767	·5365	5284	5204	5126	5049	4973	4899	4826	4754	52	66
·5378	5297	5217	5139	5062	4986	4912	4839	4767	·5365	5284	5204	5126	5049	4973	4899	4826	4754	53	67
·5378	5297	5217	5139	5062	4986	4912	4839	4767	·5365	5284	5204	5126	5049	4973	4899	4826	4754	54	68
·5378	5297	5217	5139	5062	4986	4912	4839	4767	·5365	5284	5204	5126	5049	4973	4899	4826	4754	55	69
·5377	5296	5216	5138	5061	4986	4911	4839	4766	·5365	5284	5204	5126	5049	4973	4899	4826	4754	56	71
·5377	5296	5216	5138	5061	4985	4911	4838	4766	·5364	5283	5203	5125	5048	4972	4898	4825	4753	57	72
·5377	5296	5216	5138	5061	4985	4911	4838	4766	·5364	5283	5203	5125	5048	4972	4898	4825	4753	58	73
·5377	5296	5216	5138	5061	4985	4911	4838	4766	·5364	5283	5203	5125	5048	4972	4898	4825	4753	59	74
53′	54′	55′	56′	57′	58′	59′	60′	61′	53′	54′	55′	56′	57′	58′	59′	60′	61′		

TABLE 34

Logarithms of the Apparent Altitudes and Horizontal Parallax.

′	Apparent Altitude 81°									Apparent Altitude 82°									′ or ″	″ Pr.
	Moon's Horizontal Parallax.									Moon's Horizontal Parallax.										
	53′	54′	55′	56′	57′	58′	59′	60′	61′	53′	54′	55′	56′	57′	58′	59′	60′	61′		
0	0 ·5364	5283	5203	5125	5048	4972	4898	4825	4753	0 ·5352	5271	5191	5113	5036	4960	4886	4813	4741	0	-0
1	·5364	5283	5203	5125	5048	4972	4898	4825	4753	·5352	5271	5191	5113	5036	4960	4886	4813	4741	1	1
2	·5363	5282	5202	5124	5047	4971	4897	4824	4752	·5352	5271	5191	5113	5036	4960	4886	4813	4741	2	3
3	·5363	5282	5202	5124	5047	4971	4897	4824	4752	·5352	5271	5191	5113	5036	4960	4886	4813	4741	3	4
4	·5363	5282	5202	5124	5047	4971	4897	4824	4752	·5352	5271	5191	5113	5036	4960	4886	4813	4741	4	5
5	·5363	5282	5202	5124	5047	4971	4897	4824	4752	·5352	5271	5191	5113	5036	4960	4886	4813	4741	5	6
6	·5363	5282	5202	5124	5047	4971	4897	4824	4752	·5351	5270	5190	5112	5035	4959	4885	4812	4740	6	8
7	·5362	5281	5201	5123	5046	4970	4896	4823	4751	·5351	5270	5190	5112	5035	4959	4885	4812	4740	7	9
8	·5362	5281	5201	5123	5046	4970	4896	4823	4751	·5351	5270	5190	5112	5035	4959	4885	4812	4740	8	10
9	·5362	5281	5201	5123	5046	4970	4896	4823	4751	·5351	5270	5190	5112	5035	4959	4885	4812	4740	9	11
10	·5362	5281	5201	5123	5046	4970	4896	4823	4751	·5351	5270	5190	5112	5035	4959	4885	4812	4740	10	13
11	·5362	5281	5201	5123	5046	4970	4896	4823	4751	·5351	5270	5190	5112	5035	4959	4885	4812	4740	11	14
12	·5361	5280	5200	5122	5045	4969	4895	4822	4750	·5350	5269	5189	5111	5034	4958	4884	4811	4739	12	15
13	·5361	5280	5200	5122	5045	4969	4895	4822	4750	·5350	5269	5189	5111	5034	4958	4884	4811	4739	13	17
14	·5361	5280	5200	5122	5045	4969	4895	4822	4750	·5350	5269	5189	5111	5034	4958	4884	4811	4739	14	18
15	·5361	5280	5200	5122	5045	4969	4895	4822	4750	·5350	5269	5189	5111	5034	4958	4884	4811	4739	15	19
16	·5361	5280	5200	5122	5045	4969	4895	4822	4750	·5350	5269	5189	5111	5034	4958	4884	4811	4739	16	20
17	·5360	5279	5199	5121	5044	4968	4894	4821	4749	·5350	5269	5189	5111	5034	4958	4884	4811	4739	17	22
18	·5360	5279	5199	5121	5044	4968	4894	4821	4749	·5349	5268	5188	5110	5033	4957	4883	4810	4738	18	23
19	·5360	5279	5199	5121	5044	4968	4894	4821	4749	·5349	5268	5188	5110	5033	4957	4883	4810	4738	19	24
20	·5360	5279	5199	5121	5044	4968	4894	4821	4749	·5349	5268	5188	5110	5033	4957	4883	4810	4738	20	25
21	·5360	5279	5199	5121	5044	4968	4894	4821	4749	·5349	5268	5188	5110	5033	4957	4883	4810	4738	21	27
22	·5359	5278	5198	5120	5043	4967	4893	4820	4748	·5349	5268	5188	5110	5033	4957	4883	4810	4738	22	28
23	·5359	5278	5198	5120	5043	4967	4893	4820	4748	·5348	5267	5187	5109	5032	4956	4882	4809	4737	23	29
24	·5359	5278	5198	5120	5043	4967	4893	4820	4748	·5348	5267	5187	5109	5032	4956	4882	4809	4737	24	30
25	·5359	5278	5198	5120	5043	4967	4893	4820	4748	·5348	5267	5187	5109	5032	4956	4882	4809	4737	25	32
26	·5359	5278	5198	5120	5043	4967	4893	4820	4748	·5348	5267	5187	5109	5032	4956	4882	4809	4737	26	33
27	·5359	5278	5198	5120	5043	4967	4893	4820	4748	·5348	5267	5187	5109	5032	4956	4882	4809	4737	27	34
28	·5358	5277	5197	5119	5042	4966	4892	4819	4747	·5348	5267	5187	5109	5032	4956	4882	4809	4737	28	35
29	·5358	5277	5197	5119	5042	4966	4892	4819	4747	·5347	5266	5187	5108	5031	4955	4881	4808	4736	29	37
30	·5358	5277	5197	5119	5042	4966	4892	4819	4747	·5347	5266	5186	5108	5031	4955	4881	4808	4736	30	38
31	·5358	5277	5197	5119	5042	4966	4892	4819	4747	·5347	5266	5186	5108	5031	4955	4881	4808	4736	31	39
32	·5358	5277	5197	5119	5042	4966	4892	4819	4747	·5347	5266	5186	5108	5031	4955	4881	4808	4736	32	41
33	·5357	5276	5196	5118	5041	4965	4891	4818	4746	·5347	5266	5186	5108	5031	4955	4881	4808	4736	33	42
34	·5357	5276	5196	5118	5041	4965	4891	4818	4746	·5347	5266	5186	5108	5031	4955	4881	4808	4736	34	43
35	·5357	5276	5196	5118	5041	4965	4891	4818	4746	·5346	5265	5186	5107	5030	4954	4880	4807	4735	35	44
36	.5357	5276	5196	5118	5041	4965	4891	4818	4746	·5346	5265	5185	5107	5030	4954	4880	4807	4735	36	45
37	.5357	5276	5196	5118	5041	4965	4891	4818	4746	·5346	5265	5185	5107	5030	4954	4880	4807	4735	37	47
38	.5356	5275	5195	5117	5040	4964	4890	4817	4745	·5346	5265	5185	5107	5030	4954	4880	4807	4735	38	48
39	.5356	5275	5195	5117	5040	4964	4890	4817	4745	·5346	5265	5185	5107	5030	4954	4880	4807	4735	39	49
40	·5356	5275	5195	5117	5040	4964	4890	4817	4745	·5346	5265	5185	5107	5030	4954	4880	4807	4735	40	51
41	·5356	5275	5195	5117	5040	4964	4890	4817	4745	·5346	5265	5185	5107	5030	4954	4880	4807	4735	41	52
42	·5356	5275	5195	5117	5040	4964	4890	4817	4745	·5345	5264	5184	5106	5029	4953	4879	4806	4734	42	53
43	·5356	5275	5195	5117	5040	4964	4890	4817	4745	·5345	5264	5184	5106	5029	4953	4879	4806	4734	43	54
44	·5355	5274	5194	5116	5039	4963	4889	4816	4744	·5345	5264	5184	5106	5029	4953	4879	4806	4734	44	56
45	·5355	5274	5194	5116	5039	4963	4889	4816	4744	·5345	5264	5184	5106	5029	4953	4879	4806	4734	45	57
46	·5355	5274	5194	5116	5039	4963	4889	4816	4744	·5345	5264	5184	5106	5029	4953	4879	4806	4734	46	58
47	.5355	5274	5194	5116	5039	4963	4889	4816	4744	·5345	5264	5184	5106	5029	4953	4879	4806	4734	47	59
48	·5355	5274	5194	5116	5039	4963	4889	4816	4744	·5344	5263	5183	5105	5028	4952	4878	4805	4733	48	61
49	·5354	5273	5193	5115	5038	4962	4888	4815	4743	·5344	5263	5183	5105	5028	4952	4878	4805	4733	49	62
50	·5354	5273	5193	5115	5038	4962	4888	4815	4743	·5344	5263	5183	5105	5028	4952	4878	4805	4733	50	63
51	·5354	5273	5193	5115	5038	4962	4888	4815	4743	·5344	5263	5183	5105	5028	4952	4878	4805	4733	51	64
52	·5354	5273	5193	5115	5038	4962	4888	4815	4743	·5344	5263	5183	5105	5028	4952	4878	4805	4733	52	66
53	·5354	5273	5193	5115	5038	4962	4888	4815	4743	·5344	5263	5183	5105	5028	4952	4878	4805	4733	53	67
54	·5354	5273	5193	5115	5038	4962	4888	4815	4743	·5343	5262	5182	5104	5027	4951	4877	4804	4732	54	68
55	·5353	5272	5192	5114	5037	4961	4887	4814	4742	·5343	5262	5182	5104	5027	4951	4877	4804	4732	55	69
56	·5353	5272	5192	5114	5037	4961	4887	4814	4742	·5343	5262	5182	5104	5027	4951	4877	4804	4732	56	71
57	·5353	5272	5192	5114	5037	4961	4887	4814	4742	·5343	5262	5182	5104	5027	4951	4877	4804	4732	57	72
58	·5353	5272	5192	5114	5037	4961	4887	4814	4742	·5343	5262	5182	5104	5027	4951	4877	4804	4732	58	73
59	·5353	5272	5192	5114	5037	4961	4887	4814	4742	·5343	5262	5182	5104	5027	4951	4877	4804	4732	59	74
	53′	54′	55′	56′	57′	58′	59′	60′	61′	53′	54′	55′	56′	57′	58′	59′	60′	61′		

TABLE 34

Logarithms of the Apparent Altitudes and Horizontal Parallax.

Apparent Altitude 83°									Apparent Altitude 84°									″ or ′	P.P. to ″ of Par
Moon's Horizontal Parallax.									Moon's Horizontal Parallax.										
53′	54′	55′	56′	57′	58′	59′	60′	61′	53′	54′	55′	56′	57′	58′	59′	60′	61′		
0 ·5342	5261	5181	5103	5026	4950	4876	4803	4731	0 ·5334	5253	5173	5095	5018	4942	4868	4795	4723	0	−0
·5342	5261	5181	5103	5026	4950	4876	4803	4731	.5334	5253	5173	5095	5018	4942	4868	4795	4723	1	1
·5342	5261	5181	5103	5026	4950	4876	4803	4731	.5334	5253	5173	5095	5018	4942	4868	4795	4723	2	3
·5342	5261	5181	5103	5026	4950	4876	4803	4731	·5333	5252	5172	5094	5017	4941	4867	4794	4722	3	4
·5342	5261	5181	5103	5026	4950	4876	4803	4731	·5333	5252	5172	5094	5017	4941	4867	4794	4722	4	5
·5342	5261	5181	5103	5026	4950	4876	4803	4731	·5333	5252	5172	5094	5017	4941	4867	4794	4722	5	6
·5342	5261	5181	5103	5026	4950	4876	4803	4731	·5333	5252	5172	5094	5017	4941	4867	4794	4722	6	8
·5341	5260	5180	5102	5025	4949	4875	4802	4730	·5333	5252	5172	5094	5017	4941	4867	4794	4722	7	9
·5341	5260	5180	5102	5025	4949	4875	4802	4730	·5333	5252	5172	5094	5017	4941	4867	4794	4722	8	10
·5341	5260	5180	5102	5025	4949	4875	4802	4730	·5333	5252	5172	5094	5017	4941	4867	4794	4722	9	11
·5341	5260	5180	5102	5025	4949	4875	4802	4730	·5333	5252	5172	5094	5017	4941	4867	4794	4722	10	13
·5341	5260	5180	5102	5025	4949	4875	4802	4730	·5332	5251	5171	5093	5016	4940	4866	4793	4721	11	14
·5341	5260	5180	5102	5025	4949	4875	4802	4730	·5332	5251	5171	5093	5016	4940	4866	4793	4721	12	15
·5341	5260	5180	5102	5025	4949	4875	4802	4730	·5332	5251	5171	5093	5016	4940	4866	4793	4721	13	17
·5340	5259	5179	5101	5024	4948	4874	4801	4729	·5332	5251	5171	5093	5016	4940	4866	4793	4721	14	18
·5340	5259	5179	5101	5024	4948	4874	4801	4729	·5332	5251	5171	5093	5016	4940	4866	4793	4721	15	19
·5340	5259	5179	5101	5024	4948	4874	4801	4729	·5332	5251	5171	5093	5016	4940	4866	4793	4721	16	20
·5340	5259	5179	5101	5024	4948	4874	4801	4729	·5332	5251	5171	5093	5016	4940	4866	4793	4721	17	22
·5340	5259	5179	5101	5024	4948	4874	4801	4729	·5332	5251	5171	5093	5016	4940	4866	4793	4721	18	23
·5340	5259	5179	5101	5024	4948	4874	4801	4729	·5331	5250	5170	5092	5015	4939	4865	4792	4720	19	24
·5339	5258	5178	5100	5023	4947	4873	4800	4728	·5331	5250	5170	5092	5015	4939	4865	4792	4720	20	25
·5339	5258	5178	5100	5023	4947	4873	4800	4728	·5331	5250	5170	5092	5015	4939	4865	4792	4720	21	27
·5339	5258	5178	5100	5023	4947	4873	4800	4728	·5331	5250	5170	5092	5015	4939	4865	4792	4720	22	28
·5339	5258	5178	5100	5023	4947	4873	4800	4728	·5331	5250	5170	5092	5015	4939	4865	4792	4720	23	29
·5339	5258	5178	5100	5023	4947	4873	4800	4728	·5331	5250	5170	5092	5015	4939	4865	4792	4720	24	30
·5339	5258	5178	5100	5023	4947	4873	4800	4728	·5331	5250	5170	5092	5015	4939	4865	4792	4720	25	32
·5339	5258	5178	5100	5023	4947	4873	4800	4728	·5331	5250	5170	5092	5015	4939	4865	4792	4720	26	33
·5338	5257	5177	5099	5022	4946	4873	4799	4727	·5330	5249	5169	5091	5014	4938	4864	4791	4719	27	34
·5338	5257	5177	5099	5022	4946	4872	4799	4727	·5330	5249	5169	5091	5014	4938	4864	4791	4719	28	35
·5338	5257	5177	5099	5022	4946	4872	4799	4727	·5330	5249	5169	5091	5014	4938	4864	4791	4719	29	37
·5338	5257	5177	5099	5022	4946	4872	4799	4727	·5330	5249	5169	5091	5014	4938	4864	4791	4719	30	38
·5338	5257	5177	5099	5022	4946	4872	4799	4727	·5330	5249	5169	5091	5014	4938	4864	4791	4719	31	39
·5338	5257	5177	5099	5022	4946	4872	4799	4727	·5330	5249	5169	5091	5014	4938	4864	4791	4719	32	41
·5338	5257	5177	5099	5022	4946	4872	4799	4727	·5330	5249	5169	5091	5014	4938	4864	4791	4719	33	42
·5337	5256	5176	5098	5021	4945	4871	4798	4726	·5330	5249	5169	5091	5014	4938	4864	4791	4719	34	43
·5337	5256	5176	5098	5021	4945	4871	4798	4726	·5329	5248	5168	5090	5013	4937	4863	4790	4718	35	44
·5337	5256	5176	5098	5021	4945	4871	4798	4726	·5329	5248	5168	5090	5013	4937	4863	4790	4718	36	45
·5337	5256	5176	5098	5021	4945	4871	4798	4726	·5329	5248	5168	5090	5013	4937	4863	4790	4718	37	47
·5337	5256	5176	5098	5021	4945	4871	4798	4726	·5329	5248	5168	5090	5013	4937	4863	4790	4718	38	48
·5337	5256	5176	5098	5021	4945	4871	4798	4726	·5329	5248	5168	5090	5013	4937	4863	4790	4718	39	49
·5337	5256	5176	5098	5021	4945	4871	4798	4726	·5329	5248	5168	5090	5013	4937	4863	4790	4718	40	51
·5336	5255	5175	5097	5020	4944	4870	4797	4725	·5329	5248	5168	5090	5013	4937	4863	4790	4718	41	52
·5336	5255	5175	5097	5020	4944	4870	4797	4725	·5329	5248	5168	5090	5013	4937	4863	4790	4718	42	53
·5336	5255	5175	5097	5020	4944	4870	4797	4725	·5328	5247	5167	5089	5012	4936	4862	4789	4717	43	54
·5336	5255	5175	5097	5020	4944	4870	4797	4725	·5328	5247	5167	5089	5012	4936	4862	4789	4717	44	56
·5336	5255	5175	5097	5020	4944	4870	4797	4725	·5328	5247	5167	5089	5012	4936	4862	4789	4717	45	57
·5336	5255	5175	5097	5020	4944	4870	4797	4725	·5328	5247	5167	5089	5012	4936	4862	4789	4717	46	58
·5336	5255	5175	5097	5020	4944	4870	4797	4725	·5328	5247	5167	5089	5012	4936	4862	4789	4717	47	59
·5335	5254	5174	5096	5019	4943	4869	4796	4724	·5328	5247	5167	5089	5012	4936	4862	4789	4717	48	61
·5335	5254	5174	5096	5019	4943	4869	4796	4724	·5328	5247	5167	5089	5012	4936	4862	4789	4717	49	62
·5335	5254	5174	5096	5019	4943	4869	4796	4724	·5328	5247	5167	5089	5012	4936	4862	4789	4717	50	63
·5335	5254	5174	5096	5019	4943	4869	4796	4724	·5328	5247	5167	5089	5012	4936	4862	4789	4717	51	64
·5335	5254	5174	5096	5019	4943	4869	4796	4724	·5327	5246	5166	5088	5011	4935	4861	4788	4716	52	66
·5335	5254	5174	5096	5019	4943	4869	4796	4724	·5327	5246	5166	5088	5011	4935	4861	4788	4716	53	67
·5335	5254	5174	5096	5019	4943	4869	4796	4724	·5327	5246	5166	5088	5011	4935	4861	4788	4716	54	68
·5335	5254	5174	5096	5019	4943	4869	4796	4724	·5327	5246	5166	5088	5011	4935	4861	4788	4716	55	69
·5334	5253	5173	5095	5018	4942	4868	4795	4723	·5327	5246	5166	5088	5011	4935	4861	4788	4716	56	71
·5334	5253	5173	5095	5018	4942	4868	4795	4723	·5327	5246	5166	5088	5011	4935	4861	4788	4716	57	72
·5334	5253	5173	5095	5018	4942	4868	4795	4723	·5327	5246	5166	5088	5011	4935	4861	4788	4716	58	73
·5334	5253	5173	5095	5018	4942	4868	4795	4723	·5327	5246	5166	5088	5011	4935	4861	4788	4716	59	74
53′	54′	55′	56′	57′	58′	59′	60′	61′	53′	54′	55′	56′	57′	58′	59′	60′	61′		

TABLE 34

Logarithms of the Apparent Altitudes and Horizontal Parallax.

′	Apparent Altitude 85° Moon's Horizontal Parallax. 53′	54′	55′	56′	57′	58′	59′	60′	61′	Apparent Altitude 86° Moon's Horizontal Parallax. 53′	54′	55′	56′	57′	58′	59′	60′	61′	′ or ″
0	0 ·5327	5246	5166	5088	5011	4935	4861	4788	4716	0 ·5321	5240	5160	5082	5005	4929	4855	4782	4710	0
1	·5326	5245	5165	5087	5010	4934	4860	4787	4715	·5320	5239	5159	5081	5004	4928	4854	4781	4709	1
2	·5326	5245	5165	5087	5010	4934	4860	4787	4715	·5320	5239	5159	5081	5004	4928	4854	4781	4709	2
3	·5326	5245	5165	5087	5010	4934	4860	4787	4715	·5320	5239	5159	5081	5004	4928	4854	4781	4709	3
4	·5326	5245	5165	5087	5010	4934	4860	4787	4715	·5320	5239	5159	5081	5004	4928	4854	4781	4709	4
5	·5326	5245	5165	5087	5010	4934	4860	4787	4715	·5320	5239	5159	5081	5004	4928	4854	4781	4709	5
6	·5326	5245	5165	5087	5010	4934	4860	4787	4715	·5320	5239	5159	5081	5004	4928	4854	4781	4709	6
7	·5326	5245	5165	5087	5010	4934	4860	4787	4715	·5320	5239	5159	5081	5004	4928	4854	4781	4709	7
8	·5326	5245	5165	5087	5010	4934	4860	4787	4715	·5320	5239	5159	5081	5004	4928	4854	4781	4709	8
9	·5326	5245	5165	5087	5010	4934	4860	4787	4715	·5320	5239	5159	5081	5004	4928	4654	4781	4709	9
10	·5325	5244	5164	5086	5009	4933	4859	4786	4714	·5320	5239	5159	5081	5004	4928	4854	4781	4709	10
11	·5825	5241	5164	5086	5009	4933	4859	4786	4714	·5320	5239	5159	5081	5004	4928	4854	4781	4709	11
12	·5325	5244	5164	5086	5009	4933	4859	4786	4714	·5320	5239	5159	5081	5004	4928	4854	4781	4709	12
13	·5325	5244	5164	5086	5009	4933	4859	4786	4714	·5319	5238	5158	5080	5003	4927	4853	4780	4708	13
14	·5325	5244	5164	5086	5009	4933	4859	4786	4714	·5319	5238	5158	5080	5003	4927	4853	4780	4708	14
15	·5325	5244	5164	5086	5009	4933	4859	4786	4714	·5319	5238	5158	5080	5003	4927	4853	4780	4708	15
16	·5325	5244	5164	5086	5009	4933	4859	4786	4714	5319	5238	5158	5080	5003	4927	4853	4780	4708	16
17	·5325	5244	5164	5086	5009	4933	4859	4786	4714	·5319	5238	5158	5080	5003	4927	4853	4780	4708	17
18	·5325	5244	5164	5086	5009	4933	4859	4786	4714	·5319	5238	5158	5080	5003	4927	4853	4780	4708	18
19	·5325	5244	5164	5086	5009	4933	4859	4786	4714	·5319	5238	5158	5080	5003	4927	4853	4780	4708	19
20	·5324	5243	5163	5085	5008	4932	4858	4785	4713	·5319	5238	5158	5080	5003	4927	4853	4780	4708	20
21	·5324	5243	5163	5085	5008	4932	4858	4785	4713	·5319	5238	5158	5080	5003	4927	4853	4780	4708	21
22	·5324	5243	5163	5085	5008	4932	4858	4785	4713	·5319	5238	5158	5080	5003	4927	4853	4780	4708	22
23	·5324	5243	5163	5085	5008	4932	4858	4785	4713	·5319	5238	5158	5080	5003	4927	4853	4780	4708	23
24	·5324	5243	5163	5085	5008	4932	4858	4795	4713	·5319	5238	5158	5080	5003	4927	4853	4780	4708	24
25	·5324	5243	5163	5085	5008	4932	4858	4785	4713	·5318	5237	5157	5079	5002	4926	4852	4779	4707	25
26	·5324	5243	5163	5085	5008	4932	4858	4785	4713	·5318	5237	5157	5079	5002	4926	4852	4779	4707	26
27	·5324	5243	5163	5085	5008	4932	4858	4785	4713	·5318	5237	5157	5079	5002	4926	4852	4779	4707	27
28	·5324	5243	5163	5085	5008	4932	4858	4785	4713	·5318	5237	5157	5079	5002	4926	4852	4779	4707	28
29	·5324	5243	5163	5085	5008	4932	4858	4785	4713	·5318	5237	5157	5079	5002	4926	4852	4779	4707	29
30	·5323	5242	5162	5084	5007	4931	4857	4784	4712	·5318	5237	5157	5079	5002	4926	4852	4779	4707	30
31	·5323	5242	5162	5084	5007	4931	4857	4784	4712	·5318	5237	5157	5079	5002	4926	4852	4779	4707	31
32	·5323	5242	5162	5084	5007	4931	4857	4784	4712	·5318	5237	5157	5079	5002	4926	4852	4779	4707	32
33	·5323	5242	5162	5084	5007	4931	4857	4784	4712	·5318	5237	5157	5079	5002	4926	4852	4779	4707	33
34	·5323	5242	5162	5084	5007	4931	4857	4784	4712	·5318	5237	5157	5079	5002	4926	4852	4779	4707	34
35	·5323	5242	5162	5084	5007	4931	4857	4784	4712	·5318	5237	5157	5079	5002	4926	4852	4779	4707	35
36	·5323	5242	5162	5084	5007	4931	4857	4784	4712	·5318	5237	5157	5079	5002	4926	4852	4779	4707	36
37	·5323	5242	5162	5084	5007	4931	4857	4784	4712	·5318	5237	5157	5079	5002	4926	4852	4779	4707	37
38	·5323	5242	5162	5084	5007	4931	4857	4784	4712	·5318	5236	5156	5078	5001	4925	4851	4778	4706	38
39	·5323	5242	5162	5084	5007	4931	4857	4784	4712	·5318	5236	5156	5078	5001	4925	4851	4778	4706	39
40	·5322	5241	5161	5083	5006	4930	4856	4783	4711	·5317	5236	5156	5078	5001	4925	4851	4778	4706	40
41	·5322	5241	5161	5083	5006	4930	4856	4783	4711	·5317	5236	5156	5078	5001	4925	4851	4778	4706	41
42	·5322	5241	5161	5083	5006	4930	4856	4783	4711	·5317	5236	5156	5078	5001	4925	4851	4778	4706	42
43	·5322	5241	5161	5083	5006	4930	4856	4783	4711	·5317	5236	5156	5078	5001	4925	4851	4778	4706	43
44	·5322	5241	5161	5083	5006	4930	4856	4783	4711	·5317	5236	5156	5078	5001	4925	4851	4778	4706	44
45	·5322	5241	5161	5083	5006	4930	4856	4783	4711	·5317	5236	5156	5078	5001	4925	4851	4778	4706	45
46	·5322	5241	5161	5083	5006	4930	4856	4783	4711	·5317	5236	5156	5078	5001	4925	4851	4778	4706	46
47	·5322	5241	5161	5083	5006	4930	4856	4783	4711	·5317	5236	5156	5078	5001	4925	4851	4778	4706	47
48	·5322	5241	5161	5083	5006	4930	4856	4783	4711	·5317	5236	5156	5078	5001	4925	4851	4778	4706	48
49	·5322	5241	5161	5083	5006	4930	4856	4783	4711	·5317	5236	5156	5078	5001	4925	4851	4778	4706	49
50	·5321	5240	5160	5082	5005	4929	4855	4782	4710	·5317	5236	5156	5078	5001	4925	4851	4778	4706	50
51	·5321	5240	5160	5082	5005	4929	4855	4782	4710	·5317	5236	5156	5078	5001	4925	4851	4778	4706	51
52	·5321	5240	5160	5082	5005	4929	4855	4782	4710	·5316	5235	5155	5077	5000	4924	4850	4777	4705	52
53	·5321	5240	5160	5082	5005	4929	4855	4782	4710	·5316	5235	5155	5077	5000	4924	4850	4777	4705	53
54	·5321	5240	5160	5082	5005	4929	4855	4782	4710	·5316	5235	5155	5077	5000	4924	4850	4777	4705	54
55	·5321	5240	5160	5082	5005	4929	4855	4782	4710	·5316	5235	5155	5077	5000	4924	4850	4777	4705	55
56	·5321	5240	5160	5082	5005	4929	4855	4782	4710	·5316	5235	5155	5077	5000	4924	4850	4777	4705	56
57	·5321	5240	5160	5082	5005	4929	4855	4782	4710	·5316	5235	5155	5077	5000	4924	4850	4777	4705	57
58	·5321	5240	5160	5082	5005	4929	4855	4782	4710	·5316	5235	5155	5077	5000	4924	4850	4777	4705	58
59	·5321	5240	5160	5082	5005	4929	4855	4782	4710	·5316	5235	5155	5077	5000	4924	4850	4777	4705	59

TABLE 34

Logarithms of tne Apparent Altitudes and Horizontal Parallax.

Apparent Altitude 87°									Apparent Altitude 88°										P.P. to ″ of Par.
Moon's Horizontal Parallax.									Moon's Horizontal Parallax.									′ or ″	
53′	54′	55′	56′	57′	58′	59′	60′	61′	53′	54′	55′	56′	57′	58′	59′	60′	61′		
·5316	5235	5155	5077	5000	4924	4850	4777	4705	0·5313	5232	5152	5074	4997	4921	4847	4774	4702	0	—0
·5316	5235	5155	5077	5000	4924	4850	4777	4705	·5313	5232	5152	5074	4997	4921	4847	4774	4702	1	1
5316	5235	5155	5077	5000	4924	4850	4777	4705	·5313	5232	5152	5074	4997	4921	4847	4774	4702	2	3
·5316	5235	5155	5077	5000	4924	4850	4777	4705	·5313	5232	5152	5074	4997	4921	4847	4774	4702	3	4
·5316	5235	5155	5077	5000	4924	4850	4777	4705	·5312	5231	5151	5073	4996	4920	4846	4773	4701	4	5
·5316	5235	5155	5077	5000	4924	4850	4777	4705	·5312	5231	5151	5073	4996	4920	4846	4773	4701	5	6
·5315	5234	5154	5076	4999	4923	4849	4776	4704	·5312	5231	5151	5073	4996	4920	4846	4773	4701	6	8
·5315	5234	5154	5076	4999	4923	4849	4776	4704	·5312	5231	5151	5073	4996	4920	4846	4773	4701	7	9
·5315	5234	5154	5076	4999	4923	4849	4776	4704	·5312	5231	5151	5073	4996	4920	4846	4773	4701	8	10
·5315	5234	5154	5076	4999	4923	4849	4776	4704	·5312	5231	5151	5073	4996	4920	4846	4773	4701	9	11
·5315	5234	5154	5076	4999	4923	4849	4776	4704	·5312	5231	5151	5073	4996	4920	4846	4773	4701	10	13
·5315	5234	5154	5076	4999	4923	4849	4776	4704	·5312	5231	5151	5073	4996	4920	4846	4773	4701	11	14
·5315	5234	5154	5076	4999	4923	4849	4776	4704	·5312	5231	5151	5073	4996	4920	4846	4773	4701	12	15
·5315	5234	5154	5076	4999	4923	4849	4776	4704	·5312	5231	5151	5073	4996	4920	4846	4773	4701	13	17
·5315	5234	5154	5076	4999	4923	4849	4776	4704	·5312	5231	5151	5073	4996	4920	4846	4773	4701	14	18
·5315	5234	5154	5076	4999	4923	4849	4776	4704	·5312	5231	5151	5073	4996	4920	4846	4773	4701	15	19
·5315	5234	5154	5076	4999	4923	4849	4776	4704	·5312	5231	5151	5073	4996	4920	4846	4773	4701	16	20
·5315	5234	5154	5076	4999	4923	4849	4776	4704	·5312	5231	5151	5073	4996	4920	4846	4773	4701	17	22
·5315	5234	5155	5076	4999	4923	4849	4776	4704	·5312	5231	5151	5073	4996	4920	4846	4773	4701	18	23
·5315	5234	5154	5076	4999	4923	4849	4776	4704	·5312	5231	5151	5073	4996	4920	4846	4773	4701	19	24
·5315	5234	5154	5076	4999	4923	4849	4776	4704	·5312	5231	5151	5073	4996	4920	4846	4773	4701	20	25
·5315	5234	5154	5076	4999	4923	4849	4776	4704	·5312	5231	5151	5073	4996	4920	4846	4773	4701	21	27
·5315	5234	5154	5076	4999	4923	4849	4776	4704	·5312	5231	5151	5073	4996	4920	4846	4773	4701	22	28
·5315	5234	5154	5076	4999	4923	4849	4776	4704	·5312	5231	5151	5073	4996	4920	4846	4773	4701	23	29
·5314	5233	5154	5075	4998	4922	4848	4775	4703	·5312	5231	5151	5073	4996	4920	4846	4773	4701	24	30
·5314	5233	5153	5075	4998	4922	4848	4775	4703	·5312	5231	5151	5073	4996	4920	4846	4773	4701	25	32
·5314	5233	5153	5075	4998	4922	4848	4775	4703	·5312	5231	5151	5073	4996	4920	4846	4773	4701	26	33
·5314	5233	5153	5075	4998	4922	4848	4775	4703	·5312	5231	5151	5073	4996	4920	4846	4773	4701	27	34
·5314	5233	5153	5075	4998	4922	4848	4775	4703	·5312	5231	5151	5073	4996	4920	4846	4773	4701	28	35
·5314	5233	5153	5075	4998	4922	4848	4775	4703	·5312	5231	5151	5073	4996	4920	4846	4773	4701	29	37
·5314	5233	5153	5075	4998	4922	4848	4775	4703	·5311	5230	5150	5072	4995	4919	4845	4772	4700	30	38
·5314	5233	5153	5075	4998	4922	4848	4775	4703	·5311	5230	5150	5072	4995	4919	4845	4772	4700	31	39
·5314	5233	5153	5075	4998	4922	4848	4775	4703	·5311	5230	5150	5072	4995	4919	4845	4772	4700	32	41
·5314	5233	5153	5075	4998	4922	4848	4775	4703	·5311	5230	5150	5072	4995	4919	4845	4772	4700	33	42
·5314	5233	5153	5075	4998	4922	4848	4775	4703	·5311	5230	5150	5072	4995	4919	4845	4772	4700	34	43
·5314	5233	5153	5075	4998	4922	4848	4775	4703	·5311	5230	5150	5072	4995	4919	4845	4772	4700	35	44
·5314	5233	5153	5075	4998	4922	4848	4775	4703	·5311	5230	5150	5072	4995	4919	4845	4772	4700	36	45
·5314	5233	5153	5075	4998	4922	4848	4775	4703	·5311	5230	5150	5072	4995	4919	4845	4772	4700	37	47
·5314	5233	5153	5075	4998	4922	4848	4775	4703	·5311	5230	5150	5072	4995	4919	4845	4772	4700	38	48
·5314	5233	5153	5075	4998	4922	4848	4775	4703	·5311	5230	5150	5072	4995	4919	4845	4772	4700	39	49
·5314	5233	5153	5075	4998	4922	4848	4775	4703	·5311	5230	5150	5072	4995	4919	4845	4772	4700	40	51
·5314	5233	5153	5075	4998	4922	4848	4775	4703	·5311	5230	5150	5072	4995	4919	4845	4772	4700	41	52
·5313	5232	5152	5074	4997	4921	4847	4774	4702	·5311	5230	5150	5072	4995	4919	4845	4772	4700	42	53
·5313	5232	5152	5074	4997	4921	4847	4774	4702	·5311	5230	5150	5072	4995	4919	4845	4772	4700	43	54
·5313	5232	5152	5074	4997	4921	4847	4774	4702	·5311	5230	5150	5072	4995	4919	4845	4772	4700	44	56
·5313	5232	5152	5074	4997	4921	4847	4774	4702	·5311	5230	5150	5072	4995	4919	4845	4772	4700	45	57
·5313	5232	5152	5074	4997	4921	4847	4774	4702	5311	5230	5150	5072	4995	4919	4845	4772	4700	46	58
·5313	5232	5152	5074	4997	4921	4847	4774	4702	·5311	5230	5150	5072	4995	4919	4845	4772	4700	47	59
·5313	5232	5152	5074	4997	4921	4847	4774	4702	·5311	5230	5150	5072	4995	4919	4845	4772	4700	48	61
·5313	5232	5152	5074	4997	4921	4847	4774	4702	·5311	5230	5150	5072	4995	4919	4845	4772	4700	49	62
·5313	5232	5152	5074	4997	4921	4847	4774	4702	·5311	5230	5150	5072	4995	4919	4845	4772	4700	50	63
·5313	5232	5152	5074	4997	4921	4847	4774	4702	·5311	5230	5150	5072	4995	4919	4845	4772	4700	51	64
·5313	5232	5152	5074	4997	4921	4847	4774	4702	·5311	5230	5150	5072	4995	4919	4845	4772	4700	52	66
·5313	5232	5152	5074	4997	4921	4847	4774	4702	·5311	5230	5150	5072	4995	4919	4845	4772	4700	53	67
·5313	5232	5152	5074	4997	4921	4847	4774	4702	·5311	5230	5150	5072	4995	4919	4845	4772	4700	54	68
·5313	5232	5152	5074	4997	4921	4847	4774	4702	·5311	5230	5150	5072	4995	4919	4845	4772	4700	55	69
·5313	5232	5152	5074	4997	4921	4847	4774	4702	·5311	5230	5150	5072	4995	4919	4845	4772	4700	56	71
·5313	5232	5152	5074	4997	4921	4847	4774	4702	·5311	5230	5150	5072	4995	4919	4845	4772	4700	57	72
·5313	5232	5152	5074	4997	4921	4847	4774	4702	.5311	5230	5150	5072	4995	4919	4845	4772	4700	58	73
·5313	5232	5152	5074	4997	4921	4847	4774	4702	·5311	5230	5150	5072	4995	4919	4845	4772	4700	59	74
53′	54′	55′	56′	57′	58′	59′	60′	61′	53′	54′	55′	56′	57′	58′	59′	60′	61′		

TABLE 35.

PROPORTIONAL LOGARITHMS.

s ″	h m 0° 0′	h m 0° 1′	h m 0° 2′	h m 0° 3′	h m 0° 4′	h m 0° 5′	h m 0° 6′	h m 0° 7′	h m 0° 8′	s ″
0		2·2553	1·9542	1·7782	1·6532	1·5563	1·4771	1·4102	1·3522	0
1	4·0334	2·2481	1·9506	1·7757	1·6514	1·5549	1·4759	1·4091	1·3513	1
2	3·7324	2·2410	1·9471	1·7734	1·6496	1·5534	1·4747	1·4081	1·3504	2
3	3·5563	2·2341	1·9435	1·7710	1·6478	1·5520	1·4735	1·4071	1·3495	3
4	3·4314	2·2272	1·9400	1·7686	1·6460	1·5506	1·4723	1·4061	1·3486	4
5	3·3345	2·2205	1·9365	1·7663	1·6443	1·5491	1·4711	1·4050	1·3477	5
6	3·2553	2·2139	1·9331	1·7639	1·6425	1·5477	1·4699	1·4040	1·3468	6
7	3·1883	2·2073	1·9296	1·7616	1·6407	1·5463	1·4688	1·4030	1·3459	7
8	3·1303	2·2009	1·9262	1·7593	1·6390	1·5449	1·4676	1·4020	1·3450	8
9	3·0792	2·1946	1·9228	1·7570	1·6372	1·5435	1·4664	1·4010	1·3441	9
10	3·0334	2·1883	1·9195	1·7547	1·6355	1·5421	1·4652	1·4000	1·3432	10
11	2·9920	2·1822	1·9162	1·7524	1·6338	1·5407	1·4640	1·3989	1·3423	11
12	2·9542	2·1761	1·9128	1·7501	1·6320	1·5393	1·4629	1·3979	1·3415	12
13	2·9195	2·1701	1·9096	1·7479	1·6303	1·5379	1·4617	1·3960	1·3406	13
14	2·8873	2·1642	1·9063	1·7456	1·6286	1·5365	1·4606	1·3959	1·3397	14
15	2·8573	2·1584	1·9031	1·7434	1·6269	1·5351	1·4594	1·3949	1·3388	15
16	2·8293	2·1526	1·8999	1·7412	1·6252	1·5337	1·4582	1·3939	1·3379	16
17	2·8030	2·1469	1·8967	1·7390	1·6235	1·5324	1·4571	1·3929	1·3371	17
18	2·7782	2·1413	1·8935	1·7368	1·6218	1·5310	1·4559	1·3919	1·3362	18
19	2·7547	2·1358	1·8904	1·7346	1·6201	1·5296	1·4548	1·3910	1·3353	19
20	2·7324	2·1303	1·8873	1·7324	1·6185	1·5283	1·4536	1·3900	1·3345	20
21	2·7112	2·1249	1·8842	1·7302	1·6168	1·5269	1·4525	1·3890	1·3336	21
22	2·6910	2·1196	1·8811	1·7281	1·6151	1·5256	1·4514	1·3880	1·3327	22
23	2·6717	2·1143	1·8781	1·7259	1·6135	1·5242	1·4502	1·3870	1·3319	23
24	2·6532	2·1091	1·8751	1·7238	1·6118	1·5229	1·4491	1·3860	1·3310	24
25	2·6355	2·1040	1·8721	1·7217	1·6102	1·5215	1·4480	1·3851	1·3301	25
26	2·6185	2·0989	1·8691	1·7196	1·6085	1·5202	1·4468	1·3841	1·3293	26
27	2·6021	2·0939	1·8661	1·7175	1·6069	1·5189	1·4457	1·3831	1·3284	27
28	2·5863	2·0889	1·8632	1·7154	1·6053	1·5175	1·4446	1·3821	1·3276	28
29	2·5710	2·0840	1·8602	1·7133	1·6037	1·5162	1·4435	1·3812	1·3267	29
30	2·5563	2·0792	1·8573	1·7112	1·6021	1·5149	1·4424	1·3802	1·3259	30
31	2·5421	2·0744	1·8544	1·7091	1·6005	1·5136	1·4412	1·3792	1·3250	31
32	2·5283	2·0696	1·8516	1·7071	1·5989	1·5123	1·4401	1·3783	1·3242	32
33	2·5149	2·0649	1·8487	1·7050	1·5973	1·5110	1·4390	1·3773	1·3233	33
34	2·5019	2·0603	1·8459	1·7030	1·5957	1·5097	1·4379	1·3764	1·3225	34
35	2·4894	2·0557	1·8431	1·7010	1·5941	1·5084	1·4368	1·3754	1·3216	35
36	2·4771	2·0512	1·8403	1·6990	1·5925	1·5071	1·4357	1.3745	1·3208	36
37	2·4652	2·0467	1·8375	1·6970	1·5909	1·5058	1·4346	1·3735	1·3199	37
38	2·4536	2·0422	1·8348	1·6950	1·5894	1·5045	1·4335	1·3726	1·3191	38
39	2·4424	2·0378	1·8320	1·6930	1·5878	1·5032	1·4325	1·3716	1·3183	39
40	2·4314	2·0334	1·8293	1·6910	1·5863	1·5019	1·4314	1·3707	1·3174	40
41	2·4206	2·0291	1·8266	1·6890	1·5847	1·5007	1.4303	1·3697	1·3166	41
42	2·4102	2·0248	1·8239	1·6871	1·5832	1·4994	1·4292	1·3688	1·3158	42
43	2·4000	2·0206	1·8212	1·6851	1·5816	1·4981	1·4281	1·3678	1·3149	43
44	2·3900	2·0164	1·8186	1·6832	1·5801	1·4969	1·4270	1·3669	1·3141	44
45	2·3802	2·0122	1·8159	1·6812	1·5786	1·4956	1·4260	1·3660	1·3133	45
46	2·3707	2·0081	1·8133	1·6793	1·5771	1·4943	1·4249	1·3650	1·3124	46
47	2·3613	2·0040	1·8107	1·6774	1·5755	1·4931	1·4238	1·3641	1·3116	47
48	2·3522	2·0000	1·8081	1·6755	1·5740	1·4918	1·4228	1·3632	1·3108	48
49	2·3432	1·9960	1·8055	1·6736	1·5725	1·4906	1·4217	1·3623	1·3100	49
50	2.3345	1·9920	1·8030	1·6717	1·5710	1·4894	1·4206	1·3613	1·3091	50
51	2·3259	1·9881	1·8004	1·6698	1·5695	1·4881	1·4196	1·3604	1·3083	51
52	2·3174	1·9842	1·7979	1·6679	1·5680	1·4869	1·4185	1·3595	1·3075	52
53	2·3091	1·9803	1·7954	1·6661	1·5666	1·4856	1·4175	1·3586	1·3067	53
54	2·3010	1·9765	1·7929	1·6642	1·5651	1·4844	1·4164	1·3576	1·3059	54
55	2·2931	1·9727	1·7904	1·6624	1·5636	1·4832	1·4154	1·3567	1·3051	55
56	2·2852	1·9690	1·7879	1·6605	1·5621	1·4820	1·4143	1·3558	1·3043	56
57	2·2775	1·9652	1·7855	1·6587	1·5607	1·4808	1·4133	1·3549	1·3034	57
58	2·2700	1·9615	1·7830	1·6568	1·5592	1·4795	1·4122	1·3540	1·3026	58
59	2·2626	1·9579	1·7806	1·6550	1·5578	1·4783	1·4112	1·3531	1·3018	59
″	0° 0′	0° 1′	0° 2′	0° 3′	0° 4′	0° 5′	0° 6′	0° 7′	0° 8′	″

TABLE 35.

Proportional Logarithms.

s ″	h m 0° 9′	h m 0° 10′	h m 0° 11′	h m 0° 12′	h m 0° 13′	h m 0° 14′	h m 0° 15′	h m 0° 16′	h m 0° 17′	s ″
0	1 3010	1·2553	1·2139	1·1761	1·1413	1·1091	1·0792	1·0512	1·0248	0
1	1·3002	1·2545	1·2132	1·1755	1·1408	1·1086	1·0787	1·0507	1·0244	1
2	1·2994	1·2538	1·2126	1·1749	1·1402	1·1081	1·0782	1·0502	1·0240	2
3	1·2986	1·2531	1·2119	1·1743	1·1397	1·1076	1 0777	1·0498	1·0235	3
4	1·2978	1·2524	1·2113	1·1737	1·1391	1·1071	1·0773	1·0493	1·0231	4
5	1·2970	1·2517	1·2106	1·1731	1·1386	1·1066	1·0768	1·0489	1·0227	5
6	1·2962	1·2510	1·2099	1·1725	1·1380	1·1061	1·0763	1·0484	1·0223	6
7	1·2954	1·2502	1·2093	1·1719	1·1374	1·1055	1·0758	1·0480	1·0219	7
8	1·2946	1·2495	1·2086	1·1713	1·1369	1·1050	1·0753	1·0475	1·0214	8
9	1·2939	1·2488	1·2080	1·1707	1·1363	1·1045	1·0749	1·0471	1·0210	9
10	1·2931	1·2481	1·2073	1·1701	1·1358	1·1040	1·0744	1·0467	1·0206	10
11	1·2923	1·2474	1·2067	1·1695	1·1352	1·1035	1·0739	1·0462	1·0202	11
12	1·2915	1·2467	1·2061	1·1689	1·1347	1·1030	1·0734	1·0458	1·0197	12
13	1·2907	1·2460	1·2054	1·1683	1·1342	1·1025	1·0730	1·0453	1·0193	13
14	1·2899	1·2453	1·2048	1·1677	1·1336	1·1020	1·0725	1·0449	1·0189	14
15	1·2891	1·2445	1·2041	1·1671	1·1331	1·1015	1·0720	1·0444	1·0185	15
16	1·2883	1·2438	1·2035	1·1665	1·1325	1·1009	1·0715	1·0440	1·0181	16
17	1·2876	1·2431	1·2028	1·1660	1·1320	1·1004	1·0711	1·0435	1·0176	17
18	1·2868	1·2424	1·2022	1·1654	1·1314	1·0999	1·0706	1·0431	1·0172	18
19	1·2860	1·2417	1·2016	1·1648	1·1309	1·0994	1·0701	1·0426	1·0168	19
20	1·2852	1·2410	1·2009	1·1642	1·1303	1·0989	1·0696	1·0422	1·0164	20
21	1·2845	1·2403	1·2003	1·1636	1·1298	1·0984	1·0692	1·0418	1·0160	21
22	1·2837	1·2396	1·1996	1·1630	1·1292	1·0979	1·0687	1·0413	1·0156	22
23	1·2829	1·2389	1·1990	1·1624	1·1287	1·0974	1·0682	1·0409	1·0151	23
24	1·2821	1·2382	1·1984	1·1619	1·1282	1·0969	1·0678	1·0404	1·0147	24
25	1·2814	1·2375	1·1977	1·1613	1·1276	1·0964	1·0673	1·0400	1·0143	25
26	1·2806	1·2368	1·1971	1·1607	1·1271	1·0959	1·0668	1·0395	1·0139	26
27	1·2798	1·2362	1·1965	1·1601	1·1266	1·0954	1·0663	1·0391	1·0135	27
28	1·2791	1·2355	1·1958	1·1595	1·1260	1·0949	1·0659	1·0387	1·0131	28
29	1·2783	1·2348	1·1952	1·1589	1·1255	1·0944	1·0654	1·0382	1·0126	29
30	1·2775	1·2341	1·1946	1·1584	1·1249	1·0939	1·0649	1·0378	1·0122	30
31	1·2768	1·2334	1·1939	1·1578	1·1244	1·0934	1·0645	1·0374	1·0118	31
32	1·2760	1·2327	1·1933	1·1572	1·1239	1·0929	1·0640	1·0369	1·0114	32
33	1·2753	1·2320	1·1927	1·1566	1·1233	1·0924	1·0635	1·0365	1·0110	33
34	1·2745	1·2313	1·1921	1·1561	1·1228	1·0919	1·0631	1·0360	1·0106	34
35	1·2738	1·2307	1·1914	1·1555	1·1223	1·0914	1·0626	1·0356	1·0102	35
36	1·2730	1·2300	1·1908	1·1549	1·1217	1·0909	1·0621	1·0352	1·0098	36
37	1·2722	1·2293	1·1902	1·1543	1·1212	1·0904	1·0617	1 0347	1·0093	37
38	1·2715	1·2286	1·1896	1·1538	1·1207	1·0899	1·0612	1·0343	1·0089	38
39	1·2707	1·2279	1·1889	1·1532	1·1201	1·0894	1·0608	1·0339	1·0085	39
40	1·2700	1·2272	1·1883	1·1526	1·1196	1·0889	1·0603	1·0334	1·0081	40
41	1·2692	1·2266	1·1877	1·1520	1·1191	1·0884	1·0598	1·0330	1·0077	41
42	1·2685	1·2259	1·1871	1·1515	1·1186	1·0880	1·0594	1·0326	1·0073	42
43	1·2678	1·2252	1·1865	1·1509	1·1180	1·0875	1·0589	1·0321	1·0069	43
44	1·2670	1·2245	1·1858	1 1503	1·1175	1·0870	1·0585	1·0317	1·0065	44
45	1·2663	1·2239	1·1852	1·1498	1·1170	1·0865	1·0580	1·0313	1·0061	45
46	1·2655	1·2232	1·1846	1·1492	1·1164	1·0860	1·0575	1·0308	1·0057	46
47	1·2648	1·2225	1·1840	1·1486	1·1159	1·0855	1·0571	1·0304	1·0053	47
48	1·2640	1·2218	1·1834	1·1481	1·1154	1·0850	1·0566	1·0300	1·0049	48
49	1·2633	1·2212	1·1828	1·1475	1·1149	1·0845	1·0562	1·0295	1·0044	49
50	1·2626	1·2205	1·1822	1·1469	1·1143	1·0840	1·0557	1·0291	1·0040	50
51	1·2618	1·2198	1·1816	1·1464	1·1138	1·0835	1·0552	1·0287	1·0036	51
52	1·2611	1·2192	1·1809	1·1458	1·1133	1·0831	1·0548	1·0282	1·0032	52
53	1·2604	1·2185	1·1803	1·1452	1·1128	1·0826	1·0543	1·0278	1·0028	53
54	1·2596	1·2178	1·1797	1·1447	1·1123	1·0821	1·0539	1·0274	1·0024	54
55	1·2589	1·2172	1·1791	1·1441	1·1117	1·0816	1·0534	1·0270	1·0020	55
56	1·2582	1·2165	1·1785	1·1436	1·1112	1·0811	1·0530	1·0265	1·0016	56
57	1·2574	1·2159	1·1779	1·1430	1·1107	1·0806	1·0525	1·0261	1·0012	57
58	1·2567	1·2152	1·1773	1·1424	1·1102	1·0801	1·0521	1·0257	1·0008	58
59	1·2560	1·2145	1·1767	1·1419	1·1097	1·0797	1·0516	1·0252	1·0004	59
″	0° 9′	0° 10′	0° 11′	0° 12′	0° 13′	0° 14′	0° 15′	0° 16′	0° 17	″

TABLE 35.

PROPORTIONAL LOGARITHMS.

s ″	h m 0° 18′	m 0° 19′	h m 0° 20′	h m 0° 21′	h m 0° 22′	h m 0° 23′	h m 0° 24	h m 0° 25′	h m 0° 26′	h m 0° 27′	h m 0° 28′	h m 0° 29′	s ″
0	10000	9765	9542	9331	9128	8935	8751	8573	8403	8239	8081	7929	0
1	9996	9761	9539	9327	9125	8932	8748	8570	8400	8236	8079	7926	1
2	9992	9758	9535	9324	9122	8929	8745	8568	8397	8234	8076	7924	2
3	9988	9754	9532	9320	9119	8926	8742	8565	8395	8231	8073	7921	3
4	9984	9750	9528	9317	9115	8923	8739	8562	8392	8228	8071	7919	4
5	9980	9746	9524	9313	9112	8920	8736	8559	8389	8226	8068	7916	5
6	9976	9742	9521	9310	9109	8917	8733	8556	8386	8223	8066	7914	6
7	9972	9739	9517	9306	9106	8913	8730	8553	8384	8220	8063	7911	7
8	9968	9735	9514	9303	9103	8910	8727	8550	8381	8218	8061	7909	8
9	9964	9731	9510	9300	9099	8907	8724	8547	8378	8215	8058	7906	9
10	9960	9727	9506	9296	9096	8904	8721	8544	8375	8212	8055	7904	10
11	9956	9723	9503	9293	9092	8901	8718	8542	8372	8210	8053	7901	11
12	9952	9720	9499	9289	9089	8898	8715	8539	8370	8207	8050	7899	12
13	9948	9716	9496	9286	9086	8895	8712	8536	8367	8204	8048	7896	13
14	9944	9712	9492	9283	9083	8892	8709	8533	8364	8202	8045	7894	14
15	9940	9708	9488	9279	9079	8888	8706	8530	8361	8199	8043	7891	15
16	9936	9705	9485	9276	9076	8885	8703	8527	8359	8196	8040	7889	16
17	9932	9701	9481	9272	9073	8882	8700	8524	8356	8194	8037	7887	17
18	9928	9697	9478	9269	9070	8879	8697	8522	8353	8191	8035	7884	18
19	9924	9693	9474	9266	9066	8876	8694	8519	8350	8188	8032	7882	19
20	9920	9690	9471	9262	9063	8873	8691	8516	8348	8186	8030	7879	20
21	9916	9686	9467	9259	9060	8870	8688	8513	8345	8183	8027	7877	21
22	9912	9682	9464	9255	9057	8867	8685	8510	8342	8181	8025	7874	22
23	9908	9678	9460	9252	9053	8864	8682	8507	8339	8178	8022	7872	23
24	9905	9675	9456	0249	9050	8861	8679	8504	8337	8175	8020	7869	24
25	9901	9671	9453	9245	9047	8857	8676	8502	8334	8173	8017	7867	25
26	9897	9667	9449	9242	9044	8854	8673	8499	8331	8170	8014	7864	26
27	9893	9664	9446	9238	9041	8851	8670	8496	8328	8167	8012	7862	27
28	9889	9660	9442	9235	9037	8848	8667	8493	8326	8165	8009	7859	28
29	9885	9656	9439	9232	9034	8845	8664	8490	8323	8162	8007	7857	29
30	9881	9652	9435	9228	9031	8842	8661	8487	8320	8159	8004	7855	30
31	9877	9649	9432	9225	9028	8839	8658	8484	8318	8157	8002	7852	31
32	9873	9645	9428	9222	9024	8836	8655	8482	8315	8154	7999	7850	32
33	9869	9641	9425	9218	9021	8833	8652	8479	8312	8152	7997	7847	33
34	9865	9638	9421	9215	9018	8830	8649	8476	8309	8149	7994	7845	34
35	9861	9634	9418	9212	9015	8827	8646	8473	8307	8146	7992	7842	35
36	9858	9630	9414	9208	9012	8824	8643	8470	8304	8144	7989	7840	36
37	9854	9626	9411	9205	9008	8821	8640	8467	8301	8141	7987	7837	37
38	9850	9623	9407	9201	9005	8817	8637	8465	8298	8138	7984	7835	38
39	9846	9619	9404	9198	9002	8814	8635	8462	8296	8136	7981	7832	39
40	9842	9615	9400	9195	8999	8811	8632	8459	8293	8133	7979	7830	40
41	9838	9612	9397	9191	8996	8808	8629	8456	8290	8131	7976	7828	41
42	9834	9608	9393	9188	8992	8805	8626	8453	8288	8128	7974	7825	42
43	9830	9604	9390	9185	8989	8802	8623	8451	8285	8125	7971	7823	43
44	9827	9601	9386	9181	8986	8799	8620	8448	8282	8123	7969	7820	44
45	9823	9597	9383	9178	8983	8796	8617	8445	8279	8120	7966	7818	45
46	9819	9593	9379	9175	8980	8793	8614	8442	8277	8117	7964	7815	46
47	9815	9590	9376	9172	8977	8790	8612	8439	8274	8115	7961	7813	47
48	9811	9586	9372	9168	8973	8787	8608	8437	8271	8112	7959	7811	48
49	9807	9582	9369	9165	8970	8784	8605	8434	8269	8110	7956	7808	49
50	9803	9579	9365	9162	8967	8781	8602	8431	8266	8107	7954	7806	50
51	9800	9575	9362	9158	8964	8778	8599	8428	8263	8104	7951	7803	51
52	9796	9571	9358	9155	8961	8775	8597	8425	8261	8102	7949	7801	52
53	9792	9568	9355	9152	8958	8772	8594	8423	8258	8099	7946	7798	53
54	9788	9564	9351	9148	8954	8769	8591	8420	8255	8097	7944	7796	54
55	9784	9561	9348	9145	8951	8766	8588	8417	8253	8094	7941	7794	55
56	9780	9557	9344	9142	8948	8763	8585	8414	8250	8091	7939	7791	56
57	9777	9553	9341	9138	8945	8760	8582	8411	8247	8089	7936	7789	57
58	9773	9550	9337	9135	8942	8757	8579	8409	8244	8086	7934	7786	58
59	9769	9546	9334	9132	8939	8754	8576	8406	8242	8084	7931	7784	59
″	0° 18′	0° 19′	0° 20′	0° 21′	0° 22′	0° 23′	0° 24′	0° 25′	0° 26′	0° 27′	0° 28′	0° 29′	″

Proportional Logarithms.

s ″	h m 0° 30′	h m 0° 31′	h m 0° 32′	h m 0° 33′	h m 0° 34′	h m 0° 35′	h m 0° 36′	h m 0° 37′	h m 0° 38′	h m 0° 39′	h m 0°40′	h m 0°41′	″
0	7782	7639	7501	7368	7238	7112	6990	6871	6755	6642	6532	6425	0
1	7779	7637	7499	7365	7236	7110	6988	6869	6753	6640	6530	6423	1
2	7777	7634	7497	7363	7234	7108	6986	6867	6751	6638	6529	6421	2
3	7774	7632	7494	7361	7232	7106	6984	6865	6749	6637	6527	6420	3
4	7772	7630	7492	7359	7229	7104	6982	6863	6747	6635	6525	6418	4
5	7769	7627	7490	7357	7227	7102	6980	6861	6745	6633	6523	6416	5
6	7767	7625	7488	7354	7225	7100	6978	6859	6743	6631	6521	6414	6
7	7765	7623	7485	7352	7223	7098	6976	6857	6742	6629	6519	6413	7
8	7762	7620	7483	7350	7221	7096	6974	6855	6740	6627	6518	6411	8
9	7760	7618	7481	7348	7219	7093	6972	6853	6738	6625	6516	6409	9
10	7757	7616	7479	7346	7217	7091	6970	6851	6736	6624	6514	6407	10
11	7755	7613	7476	7344	7215	7089	6968	6849	6734	6622	6512	6406	11
12	7753	7611	7474	7341	7212	7087	6966	6847	6732	6620	6510	6404	12
13	7750	7609	7472	7339	7210	7085	6964	6845	6730	6618	6509	6402	13
14	7748	7607	7470	7337	7208	7083	6962	6843	6728	6616	6507	6400	14
15	7745	7604	7467	7335	7206	7081	6960	6841	6726	6614	6505	6398	15
16	7743	7602	7465	7333	7204	7079	6958	6840	6725	6612	6503	6397	16
17	7741	7600	7463	7330	7202	7077	6956	6838	6723	6611	6501	6395	17
18	7738	7597	7461	7328	7200	7075	6954	6836	6721	6609	6500	6393	18
19	7736	7595	7458	7326	7198	7073	6952	6834	6719	6607	6498	6391	19
20	7734	7593	7456	7324	7196	7071	6950	6832	6717	6605	6496	6390	20
21	7731	7590	7454	7322	7193	7069	6948	6830	6715	6603	6494	6388	21
22	7729	7588	7452	7320	7191	7067	6946	6828	6713	6601	6492	6386	22
23	7726	7586	7450	7317	7189	7065	6944	6826	6711	6600	6491	6384	23
24	7724	7583	7447	7315	7187	7063	6942	6824	6709	6598	6489	6383	24
25	7722	7581	7445	7313	7185	7061	6940	6822	6708	6596	6487	6381	25
26	7719	7579	7443	7311	7183	7039	6938	6820	6706	6594	6486	6379	26
27	7717	7577	7441	7309	7181	7057	6936	6818	6704	6592	6484	6377	27
28	7714	7574	7438	7307	7179	7055	6934	6816	6702	6590	6482	6376	28
29	7712	7572	7436	7304	7177	7052	6932	6814	6700	6589	6480	6374	29
30	7710	7570	7434	7302	7175	7050	6930	6812	6698	6587	6478	6372	30
31	7707	7567	7432	7300	7172	7048	6928	6810	6696	6585	6476	6371	31
32	7705	7565	7429	7298	7170	7046	6926	6809	6694	6583	6475	6369	32
33	7703	7563	7427	7296	7168	7044	6924	6807	6692	6581	6473	6367	33
34	7700	7560	7425	7294	7166	7042	6922	6805	6691	6579	6471	6365	34
35	7698	7558	7423	7291	7164	7040	6920	6803	6689	6578	6469	6364	35
36	7696	7556	7421	7289	7162	7038	6918	6801	6687	6576	6467	6362	36
37	7693	7554	7418	7287	7160	7036	6916	6799	6685	6574	6466	6360	37
38	7691	7551	7416	7285	7158	7034	6914	6797	6683	6572	6464	6358	38
39	7688	7549	7414	7283	7156	7032	6912	6795	6681	6570	6462	6357	39
40	7686	7547	7412	7281	7154	7030	6910	6793	6679	6568	6460	6355	40
41	7684	7544	7409	7279	7152	7028	6908	6791	6677	6567	6459	6353	41
42	7681	7542	7407	7276	7149	7026	6906	6789	6676	6565	6457	6351	42
43	7679	7540	7405	7274	7147	7024	6904	6787	6674	6563	6455	6350	43
44	7677	7538	7403	7272	7145	7022	6902	6785	6672	6561	6453	6348	44
45	7674	7535	7401	7270	7143	7020	6900	6784	6670	6559	6451	6346	45
46	7672	7533	7398	7268	7141	7018	6898	6782	6668	6558	6450	6344	46
47	7670	7531	7396	7266	7139	7016	6896	6780	6666	6556	6448	6343	47
48	7667	7528	7394	7264	7137	7014	6894	6778	6664	6554	6446	6341	48
49	7665	7526	7392	7261	7135	7012	6892	6776	6663	6552	6444	6339	49
50	7663	7524	7390	7259	7133	7010	6890	6774	6661	6550	6443	6338	50
51	7660	7522	7387	7257	7131	7008	6888	6772	6659	6548	6441	6336	51
52	7658	7519	7385	7255	7129	7006	6886	6770	6657	6547	6439	6334	52
53	7655	7517	7383	7253	7127	7004	6884	6768	6655	6544	6437	6332	53
54	7653	7515	7381	7251	7124	7002	6882	6766	6653	6543	6435	6331	54
55	7651	7513	7379	7249	7122	7000	6881	6764	6651	6541	6434	6329	55
56	7648	7510	7376	7246	7120	6998	6879	6763	6650	6539	6432	6327	56
57	7946	7508	7374	7244	7118	6996	6877	6761	6648	6538	6430	6325	57
58	7644	7506	7372	7242	7116	6994	6875	6759	6646	6536	6428	6324	58
59	7641	7503	7370	7240	7114	6992	6873	6757	6644	6534	6427	6322	59
″	0° 30′	0° 31′	0° 32′	0° 33′	0° 34′	0° 35′	0° 36′	0° 37′	0° 38′	0° 39′	0° 40′	0° 41	″

Proportional Logarithms.

s ″	h m 0° 42′	h m 0° 43′	h m 0° 44′	h m 0° 45′	h m 0° 46′	h m 0° 47′	h m 0° 48′	h m 0° 49′	h m 0° 50′	h m 0° 51′	h m 0° 52′	h m 0° 53′	s ″
0	6320	6218	6118	6021	5925	5832	5740	5651	5563	5477	5393	5310	0
1	6319	6216	6117	6019	5924	5830	5739	5649	5562	5476	5391	5309	1
2	6317	6215	6115	6017	5922	5829	5737	5648	5560	5474	5390	5307	2
3	6315	6213	6113	6016	5920	5827	5736	5646	5559	5473	5389	5306	3
4	6313	6211	6112	6014	5919	5826	5734	5645	5557	5471	5387	5305	4
5	6312	6210	6110	6013	5917	5824	5733	5643	5556	5470	5386	5303	5
6	6310	6208	6108	6011	5916	5823	5731	5642	5554	5469	5384	5302	6
7	6308	6206	6107	6009	5914	5821	5730	5640	5553	5467	5383	5300	7
8	6306	6205	6105	6008	5913	5819	5728	5638	5551	5466	5382	5299	8
9	6305	6203	6103	6006	5911	5818	5727	5637	5550	5464	5380	5298	9
10	6303	6201	6102	6005	5909	5816	5725	5636	5549	5463	5379	5296	10
11	6301	6200	6100	6003	5908	5815	5724	5635	5547	5461	5377	5295	11
12	6300	6198	6099	6001	5906	5813	5722	5633	5546	5460	5376	5294	12
13	6298	6196	6097	6000	5905	5812	5721	5632	5544	5459	5375	5292	13
14	6296	6195	6095	5998	5903	5810	5719	5630	5543	5457	5373	5291	14
15	6294	6193	6094	5997	5902	5809	5718	5629	5541	5456	5372	5290	15
16	6293	6191	6092	5995	5900	5807	5716	5627	5540	5454	5370	5288	16
17	6291	6190	6090	5993	5898	5806	5715	5626	5538	5453	5369	5287	17
18	6289	6188	6089	5992	5897	5804	5713	5624	5537	5452	5368	5285	18
19	6288	6186	6087	5990	5895	5803	5712	5623	5536	5450	5366	5284	19
20	6286	6185	6085	5989	5894	5801	5710	5621	5534	5449	5365	5283	20
21	6284	6183	6084	5987	5892	5800	5709	5620	5533	5447	5364	5281	21
22	6282	6181	6082	5985	5891	5798	5707	5618	5531	5446	5362	5280	22
23	6281	6179	6081	5984	5889	5796	5706	5617	5530	5445	5361	5279	23
24	6279	6178	6079	5982	5888	5795	5704	5615	5528	5443	5359	5277	24
25	6277	6176	6077	5981	5886	5793	5703	5614	5527	5442	5358	5276	25
26	6276	6174	6076	5979	5884	5792	5701	5613	5526	5440	5357	5275	26
27	6274	6173	6074	5977	5883	5790	5700	5611	5524	5439	5355	5273	27
28	6272	6171	6072	5976	5881	5789	5698	5610	5522	5437	5354	5272	28
29	6271	6169	6071	5974	5880	5787	5697	5608	5521	5436	5353	5271	29
30	6269	6168	6069	5973	5878	5786	5695	5607	5520	5435	5351	5269	30
31	6267	6166	6067	5971	5877	5784	5694	5605	5518	5433	5350	5268	31
32	6265	6165	6066	5969	5875	5783	5692	5604	5517	5432	5348	5266	32
33	6264	6163	6064	5968	5874	5781	5691	5602	5516	5430	5347	5265	33
34	6262	6161	6063	5966	5872	5780	5689	5601	5514	5429	5346	5264	34
35	6260	6160	6061	5965	5870	5778	5688	5599	5513	5428	5344	5262	35
36	6259	6158	6059	5963	5869	5777	5686	5598	5511	5426	5343	5261	36
37	6257	6156	6058	5961	5867	5775	5685	5596	5510	5425	5341	5260	37
38	6255	6155	6056	5960	5866	5774	5683	5595	5508	5423	5340	5258	38
39	6254	6153	6055	5958	5864	5772	5682	5594	5507	5422	5339	5257	39
40	6252	6151	6053	5957	5863	5771	5680	5592	5506	5421	5337	5256	40
41	6250	6150	6051	5955	5861	5769	5679	5591	5504	5419	5336	5254	41
42	6248	6148	6050	5954	5860	5768	5677	5589	5503	5418	5335	5253	42
43	6247	6146	6048	5952	5858	5766	5676	5588	5501	5416	5333	5252	43
44	6245	6145	6046	5950	5856	5765	5674	5586	5500	5415	5332	5250	44
45	6243	6143	6045	5949	5855	5763	5673	5585	5498	5414	5331	5249	45
46	6242	6141	6043	5947	5853	5761	5671	5583	5497	5412	5329	5248	46
47	6240	6140	6042	5946	5852	5760	5670	5582	5496	5411	5328	5246	47
48	6238	6138	6040	5944	5850	5758	5669	5580	5494	5409	5326	5245	48
49	6237	6136	6038	5942	5849	5757	5667	5579	5493	5408	5325	5244	49
50	6235	6135	6037	5941	5847	5755	5666	5578	5491	5407	5324	5242	50
51	6233	6133	6035	5939	5846	5754	5664	5576	5490	5405	5322	5241	51
52	6232	6131	6033	5938	5844	5752	5663	5575	5488	5404	5321	5240	52
53	6230	6130	6032	5936	5843	5751	5661	5573	5487	5402	5320	5238	53
54	6228	6128	6030	5935	5841	5749	5660	5572	5486	5401	5318	5237	54
55	6226	6126	6029	5933	5839	5748	5658	5570	5484	5400	5317	5235	55
56	6225	6125	6027	5931	5838	5746	5657	5569	5483	5398	5315	5234	56
57	6223	6123	6025	5930	5836	5745	5655	5567	5481	5397	5314	5233	57
58	6221	6121	6024	5928	5835	5743	5654	5566	5480	5395	5313	5231	58
59	6220	6120	6022	5927	5833	5742	5652	5564	5478	5394	5311	5230	59
″	0° 42′	0° 43′	0° 44′	0° 45′	0° 46′	0° 47′	0° 48′	0° 49′	0° 50′	0° 51′	0° 52′	0° 53′	″

PROPORTIONAL LOGARITHMS.

″ s	h m 0° 54′	h m 0° 55′	h m 0° 56′	h m 0° 57′	h m 0° 58′	h m 0° 59′	h m 1° 0′	h m 1° 1′	h m 1° 2′	h m 1° 3′	h m 1° 4′	h m 1° 5′	″ s
0	5229	5149	5071	4994	4918	4844	4771	4699	4629	4559	4491	4424	0
1	5227	5148	5070	4993	4917	4843	4770	4698	4628	4558	4490	4422	1
2	5226	5146	5068	4991	4916	4842	4769	4697	4626	4557	4489	4421	2
3	5225	5145	5067	4990	4915	4841	4768	4696	4625	4556	4488	4420	3
4	5223	5144	5066	4989	4913	4839	4766	4695	4624	4555	4486	4419	4
5	5222	5143	5064	4988	4912	4838	4765	4693	4623	4554	4485	4418	5
6	5221	5141	5063	4986	4911	4837	4764	4692	4622	4552	4484	4417	6
7	5219	5140	5062	4985	4910	4836	4763	4691	4621	4551	4483	4416	7
8	5218	5139	5061	4984	4908	4834	4762	4690	4619	4550	4482	4415	8
9	5217	5137	5059	4983	4907	4833	4760	4689	4618	4549	4481	4414	9
10	5215	5136	5058	4981	4906	4832	4759	4688	4617	4548	4480	4412	10
11	5214	5135	5067	4980	4905	4831	4758	4686	4616	4547	4479	4411	11
12	5213	5133	5055	4979	4903	4830	4757	4685	4615	4546	4477	4410	12
13	5211	5132	5054	4977	4902	4828	4756	4684	4614	4544	4476	4409	13
14	5210	5131	5053	4976	4901	4827	4754	4683	4613	4543	4475	4408	14
15	5209	5129	5051	4975	4900	4826	4753	4682	4611	4542	4474	4407	15
16	5207	5128	5050	4974	4899	4825	4752	4680	4610	4541	4473	4406	16
17	5206	5127	5049	4972	4897	4823	4751	4679	4609	4540	4472	4405	17
18	5205	5125	5048	4971	4896	4822	4750	4678	4608	4539	4471	4404	18
19	5203	5124	5046	4970	4895	4821	4748	4677	4607	4538	4469	4402	19
20	5202	5123	5045	4969	4894	4820	4747	4676	4606	4536	4468	4401	20
21	5201	5122	5044	4967	4892	4819	4746	4675	4604	4535	4467	4400	21
22	5199	5120	5043	4966	4891	4817	4745	4673	4603	4534	4466	4399	22
23	5198	5119	5041	4965	4890	4816	4744	4672	4602	4533	4465	4398	23
24	5197	5118	5040	4964	4889	4815	4742	4671	4601	4532	4464	4397	24
25	5195	5116	5039	4962	4887	4814	4741	4670	4600	4531	4463	4396	25
26	5194	5115	5037	4961	4886	4812	4740	4669	4599	4530	4462	4395	26
27	5193	5114	5036	4960	4885	4811	4739	4668	4597	4528	4460	4394	27
28	5191	5112	5035	4959	4884	4810	4738	4666	4596	4527	4459	4393	28
29	5190	5111	5034	4957	4882	4809	4736	4665	4595	4526	4458	4391	29
30	5189	5110	5032	4956	4881	4808	4735	4664	4594	4525	4457	4390	30
31	5187	5108	5031	4955	4880	4806	4734	4663	4593	4524	4456	4389	31
32	5186	5107	5030	4954	4879	4805	4733	4662	4592	4523	4455	4388	32
33	5185	5106	5028	4952	4877	4804	4732	4660	4590	4522	4454	4387	33
34	5183	5105	5027	4951	4876	4803	4730	4659	4589	4520	4453	4386	34
35	5182	5103	5026	4950	4875	4801	4729	4658	4588	4519	4452	4385	35
36	5181	5102	5025	4949	4874	4800	4728	4657	4587	4518	4450	4384	36
37	5179	5101	5023	4947	4873	4799	4727	4656	4586	4517	4449	4383	37
38	5178	5099	5022	4946	4871	4798	4726	4655	4585	4516	4448	4381	38
39	5177	5098	5021	4945	4870	4797	4724	4653	4584	4515	4447	4380	39
40	5175	5097	5019	4943	4869	4795	4723	4652	4582	4514	4446	4379	40
41	5174	5095	5018	4942	4868	4794	4722	4651	4581	4512	4445	4378	41
42	5173	5094	5017	4941	4866	4793	4721	4650	4580	4511	4444	4377	42
43	5172	5093	5016	4940	4865	4792	4720	4649	4579	4510	4443	4376	43
44	5170	5092	5014	4938	4864	4791	4718	4648	4578	4509	4441	4375	44
45	5169	5090	5013	4937	4863	4789	4717	4646	4577	4508	4440	4374	45
46	5168	5089	5012	4936	4861	4788	4716	4645	4575	4507	4439	4373	46
47	5166	5088	5011	4935	4860	4787	4715	4644	4574	4506	4438	4372	47
48	5165	5086	5009	4933	4859	4786	4714	4643	4573	4505	4437	4370	48
49	5164	5085	5008	4932	4858	4785	4712	4642	4572	4503	4436	4369	49
50	5162	5084	5007	4931	4856	4783	4711	4640	4571	4502	4435	4368	50
51	5161	5082	5005	4930	4855	4782	4710	4639	4570	4501	4434	4367	51
52	5160	5081	5004	4928	4854	4781	4709	4638	4569	4500	4433	4366	52
53	5158	5080	5003	4927	4853	4780	4708	4637	4567	4499	4431	4365	53
54	5157	5079	5002	4926	4852	4778	4707	4636	4566	4498	4430	4364	54
55	5156	5077	5000	4925	4850	4777	4705	4635	4565	4497	4429	4363	55
56	5154	5076	4999	4923	4849	4776	4704	4633	4564	4495	4428	4362	56
57	5153	5075	4998	4922	4848	4775	4703	4632	4563	4494	4427	4361	57
58	5152	5073	4997	4921	4847	4774	4702	4631	4562	4493	4426	4359	58
59	5150	5072	4995	4920	4845	4772	4701	4630	4560	4492	4425	4358	59
″	0° 54′	0° 55′	0° 56′	1° 57′	0° 58′	0° 59′	1° 0′	1° 1′	1° 2′	1° 3′	1° 4′	1° 5′	″

TABLE 35.

Proportional Logarithms.

s ″	m 1° 6′	h m 1° 7′	h m 1° 8′	h m 1° 9′	h m 1° 10′	h m 1° 11′	h m 1° 12′	h m 1° 13′	h m 1° 14′	h m 1° 15′	h m 1° 16′	h m 1° 17′	s ″
0	4357	4292	4228	4164	4102	4040	3979	3920	3860	3802	3745	3688	0
1	4356	4291	4227	4163	4101	4039	3978	3919	3859	3801	3744	3687	1
2	4355	4290	4226	4162	4100	4038	3977	3918	3858	3800	3743	3686	2
3	4354	4289	4224	4161	4099	4037	3876	3917	3857	3799	3742	3685	3
4	4353	4288	4223	4160	4098	4036	3975	3916	3856	3798	3741	3684	4
5	4352	4287	4222	4159	4097	4035	3974	3915	3856	3797	3740	3683	5
6	4351	4285	4221	4158	4096	4034	3973	3914	3855	3796	3739	3682	6
7	4350	4284	4220	4157	4095	4033	3972	3913	3854	3795	3738	3681	7
8	4349	4283	4219	4156	4093	4032	3971	3912	3853	3794	3737	3680	8
9	4347	4282	4218	4155	4092	4031	3970	3911	3852	3793	3736	3679	9
10	4346	4281	4217	4154	4091	4030	3969	3910	3851	3792	3735	3678	10
11	4345	4280	4216	4153	4090	4029	3968	3909	3850	3792	3734	3677	11
12	4344	4279	4215	4152	4089	4028	3967	3908	3849	3791	3733	3677	12
13	4343	4278	4214	4151	4088	4027	3966	3907	3848	3790	3732	3676	13
14	4342	4277	4213	4150	4087	4026	3965	3906	3847	3789	3731	3675	14
15	4341	4276	4212	4149	4086	4025	3964	3905	3846	3788	3730	3674	15
16	4340	4275	4211	4147	4085	4024	3963	3904	3845	3787	3729	3673	16
17	4339	4274	4210	4146	4084	4023	3962	3903	3844	3786	3728	3672	17
18	4338	4273	4209	4145	4083	4022	3961	3902	3843	3785	3727	3671	18
19	4336	4271	4207	4144	4082	4021	3960	3901	3842	3784	3727	3670	19
20	4335	4270	4206	4143	4081	4020	3959	3900	3841	3783	3726	3669	20
21	4334	4269	4205	4142	4080	4019	3958	3899	3840	3782	3725	3668	21
22	4333	4268	4204	4141	4079	4018	3957	3898	3839	3781	3724	3667	22
23	4332	4267	4203	4140	4078	4017	3956	3897	3838	3780	3723	3666	23
24	4331	4266	4202	4139	4077	4016	3955	3896	3837	3779	3722	3665	24
25	4330	4265	4201	4138	4076	4015	3954	3895	3836	3778	3721	3664	25
26	4329	4264	4200	4137	4075	4014	3953	3894	3835	3777	3720	3663	26
27	4328	4263	4199	4136	4074	4013	3952	3893	3834	3776	3719	3663	27
28	4327	4262	4198	4135	4073	4012	3951	3892	3833	3775	3718	3662	28
29	4326	4261	4197	4134	4072	4011	3950	3891	3832	3774	3717	3661	29
30	4325	4260	4196	4133	4071	4010	3949	3890	3831	3773	3716	3660	30
31	4323	4259	4195	4132	4070	4009	3948	3889	3830	3772	3715	3659	31
32	4322	4253	4194	4131	4069	4008	3947	3888	3829	3771	3714	3658	32
33	4321	4256	4193	4130	4068	4007	3946	3887	3828	3770	3713	3657	33
34	4320	4255	4192	4129	4067	4006	3945	3886	3827	3769	3712	3656	34
35	4319	4254	4191	4128	4066	4005	3944	3885	3826	3768	3711	3655	35
36	4318	4253	4189	4127	4065	4004	3943	3884	3825	3768	3710	3654	36
37	4317	4252	4188	4126	4064	4003	3942	3883	3824	3767	3709	3653	37
38	4316	4251	4187	4125	4063	4002	3941	3882	3823	3766	3709	3652	38
39	4315	4250	4186	4124	4062	4001	3940	3881	3822	3765	3708	3651	39
40	4314	4249	4185	4122	4061	4000	3939	3880	3821	3764	3707	3650	40
41	4313	4248	4184	4121	4060	3999	3938	3879	3820	3763	3706	3649	41
42	4311	4247	4183	4120	4059	3998	3937	3878	3820	3762	3705	3649	42
43	4310	4246	4182	4119	4058	3997	3936	3877	3819	3761	3704	3648	43
44	4309	4245	4181	4118	4056	3996	3935	3876	3818	3760	3703	3647	44
45	4308	4244	4180	4117	4055	3995	3934	3875	3817	3759	3702	3646	55
46	4307	4242	4179	4116	4054	3993	3933	3874	3816	3758	3701	3645	46
47	4306	4241	4178	4115	4053	3992	3932	3873	3815	3757	3700	3644	47
48	4305	4240	4177	4114	4052	3991	3931	3872	3814	3756	3699	3643	48
49	4304	4239	4176	4113	4051	3990	3930	3871	3813	3755	3698	3642	49
50	4303	4238	4175	4112	4050	3989	3929	3870	3812	3754	3697	3641	50
51	4302	4237	4174	4111	4049	3988	3928	3869	3811	3753	3696	3640	51
52	4301	4236	4173	4110	4048	3987	3927	3868	3810	3752	3895	3639	52
53	4300	4234	4172	4109	4047	3986	3926	3867	3809	3751	3694	3638	53
54	4298	4234	4171	4108	4046	3985	3925	3866	3808	3750	3693	3637	54
55	4297	4233	4169	4107	4045	3984	3924	3865	3807	3749	3693	3636	55
56	4296	4232	4168	4106	4044	3983	3923	3864	3806	3748	3692	3635	56
57	4295	4231	4167	4105	4043	3982	3922	3863	3805	3747	3691	3635	57
58	4294	4230	4166	4104	4042	3981	3921	3862	3804	3746	3690	3634	58
59	4293	4229	4165	4103	4041	3980	3920	3861	3803	3746	3689	3633	59
″	1° 6′	1° 7′	1° 8′	1° 9′	1° 10′	1° 11′	1° 12′	1° 13′	1° 14′	1° 15′	1° 16′	1° 17′	″

Proportional Logarithms.

s ″	h m 1° 18′	h m 1° 19′	h m 1° 20′	h m 1° 21	h m 1° 22′	h m 1° 23′	h m 1° 24′	h m 1° 25′	h m 1° 26′	h m 1° 27′	h m 1° 28′	h m 1° 29′	s ″
0	3632	3576	3522	3468	3415	3362	3310	3259	3208	3158	3108	3059	0
1	3631	3576	3521	3467	3414	3361	3309	3258	3207	3157	3107	3058	1
2	3630	3575	3520	3466	3413	3360	3308	3257	3206	3156	3106	3057	2
3	3629	3574	3519	3465	3412	3359	3307	3256	3205	3155	3105	3056	3
4	3628	3573	3518	3464	3411	3358	3306	3255	3204	3154	3105	3056	4
5	3627	3572	3517	3463	3410	3358	3306	3254	3204	3153	3104	3055	5
6	3626	3571	3516	3463	3409	3357	3305	3253	3203	3153	3103	3054	6
7	3625	3570	3515	3462	3408	3356	3304	3253	3202	3152	3102	3053	7
8	3624	3569	3514	3461	3408	3355	3303	3252	3201	3151	3101	3052	8
9	3623	3568	3514	3460	3407	3354	3302	3251	3200	3150	3101	3052	9
10	3623	3567	3513	3459	3406	3353	3301	3250	3199	3149	3100	3051	10
11	3622	3566	3512	3458	3405	3352	3300	3249	3198	3148	3099	3050	11
12	3621	3565	3511	3457	3404	3351	3300	3248	3198	3148	3098	3049	12
13	3620	3565	3510	3456	3403	3351	3299	3247	3197	3147	3097	3048	13
14	3619	3564	3509	3455	3402	3350	3298	3247	3196	3146	3096	3047	14
15	3618	3563	3508	3454	3401	3349	3297	3246	3195	3145	3096	3047	15
16	3617	3562	3507	3454	3400	3348	3296	3245	3194	3144	3095	3046	16
17	3616	3561	3506	3453	3400	3347	3295	3244	3193	3143	3094	3045	17
18	3615	3560	3506	3452	3399	3346	3294	3243	3193	3143	3093	3044	18
19	3614	3559	3505	3451	3398	3345	3294	3242	3192	3142	3092	3043	19
20	3613	3558	3504	3450	3397	3345	3293	3242	3191	3141	3091	3043	20
21	3612	3557	3503	3449	3396	3344	3292	3241	3190	3140	3091	3042	21
22	3611	3556	3502	3448	3395	3343	3291	3240	3189	3139	3090	3041	22
23	3610	3555	3501	3447	3394	3342	3290	3239	3188	3138	3089	3040	23
24	3610	3555	3500	3446	3393	3341	3289	3238	3188	3138	3088	3039	24
25	3609	3554	3499	3446	3393	3340	3288	3237	3187	3137	3087	3039	25
26	3608	3553	3498	3445	3392	3339	3288	3236	3186	3136	3087	3038	26
27	3607	3552	3497	3444	3391	3338	3287	3236	3185	3135	3086	3037	27
28	3606	3551	3497	3443	3390	3338	3286	3235	3184	3134	3085	3036	28
29	3605	3550	3496	3442	3389	3337	3285	3234	3183	3133	3084	3035	29
30	3604	3549	3495	3441	3388	3336	3284	3233	3183	3133	3083	3034	30
31	3603	3548	3494	3440	3387	3335	3283	3232	3182	3132	3082	3034	31
32	3602	3547	3493	3439	3386	3334	3282	3231	3181	3131	3082	3033	32
33	3601	3546	3492	3438	3386	3333	3282	3231	3180	3130	3081	3032	33
34	3600	3545	3491	3438	3385	3332	3281	3230	3179	3129	3080	3031	34
35	3599	3545	3490	3437	3384	3332	3280	3229	3178	3129	3079	3030	35
36	3598	3544	3489	3436	3383	3331	3279	3228	3178	3128	3078	3030	36
37	3598	3543	3488	3435	3382	3330	3278	3227	3177	3127	3077	3029	37
38	3597	3542	3488	3434	3381	3329	3277	3226	3176	3126	3076	3028	38
39	3596	3541	3487	3433	3380	3328	3276	3225	3175	3125	3076	3027	39
40	3595	3540	3486	3432	3379	3327	3276	3225	3174	3124	3075	3026	40
41	3594	3539	3485	3431	3379	3326	3275	3224	3173	3124	3074	3026	41
42	3593	3538	3484	3431	3378	3325	3274	3223	3173	3123	3073	3025	42
43	3592	3537	3483	3430	3377	3325	3273	3222	3172	3122	3073	3024	43
44	3591	3536	3482	3429	3376	3324	3272	3221	3171	3121	3072	3023	44
45	3590	3535	3481	3428	3375	3323	3271	3220	3170	3120	3071	3022	45
46	3589	3535	3480	3427	3374	3322	3270	3220	3169	3119	3070	3022	46
47	3588	3534	3480	3426	3373	3321	3270	3219	3168	3119	3069	3021	47
48	3587	3533	3479	3425	3372	3320	3269	3218	3168	3118	3069	3020	48
49	3587	3532	3478	3424	3372	3319	3268	3217	3167	3117	3068	3019	49
50	3586	3531	3477	3423	3371	3319	3267	3216	3166	3116	3067	3018	50
51	3585	3530	3476	3423	3370	3318	3266	3215	3165	3115	3066	3018	51
52	3584	3529	3475	3422	3369	3317	3265	3214	3164	3114	3065	3017	52
53	3583	3528	3474	3421	3368	3316	3265	3213	3163	3114	3065	3016	53
54	3582	3527	3473	3420	3367	3315	3264	3213	3163	3113	3064	3015	54
55	3581	3526	3472	3419	3366	3314	3263	3212	3162	3112	3063	3014	55
56	3580	3525	3471	3418	3365	3313	3262	3211	3161	3111	3062	3014	56
57	3579	3525	3471	3417	3365	3313	3261	3210	3160	3110	3061	3013	57
58	3578	3524	3470	3416	3364	3312	3260	3209	3159	3110	3060	3012	58
59	3577	3523	3469	3415	3363	3311	3259	3209	3158	3109	3060	3011	59
″	1° 18′	1° 19′	1° 20′	1° 21′	1° 22′	1° 23′	1° 24′	1° 25′	1° 26′	1° 27′	1° 28′	1° 29′	″

TABLE 35.

PROPORTIONAL LOGARITHMS.

s ″	h m 1° 30′	h m 1° 31′	h m 1° 32′	h m 1° 33′	h m 1° 34′	h m 1° 35′	h m 1° 36′	h m 1° 37′	h m 1° 38′	h m 1° 39′	h m 1° 40′	h m 1° 41′	s ″
0	3010	2962	2915	2868	2821	2775	2730	2685	2640	2596	2553	2510	0
1	3009	2962	2914	2867	2821	2775	2729	2684	2640	2596	2552	2509	1
2	3009	2961	2913	2866	2820	2774	2729	2684	2639	2595	2551	2508	2
3	3008	2960	2912	2866	2819	2773	2728	2683	2638	2594	2551	2507	3
4	3007	2959	2912	2865	2818	2772	2727	2682	2638	2593	2550	2507	4
5	3006	2958	2911	2864	2818	2772	2726	2681	2637	2593	2549	2506	5
6	3005	2958	2910	2863	2817	2771	2725	2681	2636	2592	2548	2505	6
7	3005	2957	2909	2862	2816	2770	2725	2680	2635	2591	2548	2504	7
8	3004	2956	2909	2862	2815	2769	2724	2679	2635	2591	2547	2504	8
9	3003	2955	2908	2861	2815	2769	2723	2678	2634	2590	2546	2503	9
10	3002	2954	2907	2860	2814	2768	2722	2678	2633	2589	2545	2502	10
11	3001	2954	2906	2859	2813	2767	2722	2677	2632	2588	2545	2502	11
12	3001	2953	2905	2859	2812	2766	2721	2676	2632	2588	2544	2501	12
13	3000	2952	2905	2858	2811	2766	2720	2675	2631	2587	2543	2500	13
14	2999	2951	2904	2857	2811	2765	2719	2675	2630	2586	2543	2499	14
15	2998	2950	2903	2856	2810	2764	2719	2674	2630	2585	2542	2499	15
16	2997	2950	2902	2855	2809	2763	2718	2673	2629	2585	2541	2498	16
17	2997	2949	2901	2855	2808	2763	2717	2672	2628	2584	2540	2497	17
18	2996	2948	2901	2854	2808	2762	2716	2672	2627	2583	2540	2497	18
19	2995	2947	2900	2853	2807	2761	2716	2671	2626	2583	2539	2496	19
20	2994	2946	2899	2852	2806	2760	2715	2670	2626	2582	2538	2495	20
21	2993	2946	2898	2852	2805	2760	2714	2669	2625	2581	2538	2494	21
22	2993	2945	2898	2851	2805	2759	2713	2669	2624	2580	2537	2494	22
23	2992	2944	2897	2850	2804	2758	2713	2668	2624	2580	2536	2493	23
24	2991	2943	2896	2849	2803	2757	2712	2667	2623	2579	2535	2492	24
25	2990	2942	2895	2848	2802	2756	2711	2666	2622	2578	2535	2492	25
26	2989	2942	2894	2848	2801	2756	2710	2666	2621	2577	2534	2491	26
27	2989	2941	2894	2847	2801	2755	2710	2665	2621	2577	2532	2490	27
28	2988	2940	2893	2846	2800	2754	2709	2664	2620	2576	2533	2489	28
29	2987	2939	2892	2845	2799	2753	2708	2663	2619	2575	2532	2489	29
30	2986	2939	2891	2845	2798	2753	2707	2663	2618	2574	2531	2488	30
31	2985	2938	2891	2844	2798	2752	2707	2662	2618	2574	2530	2487	31
32	2985	2937	2890	2843	2797	2751	2706	2661	2617	2573	2530	2487	32
33	2984	2936	2889	2842	2796	2750	2705	2660	2616	2572	2529	2486	33
34	2983	2935	2888	2842	2795	2750	2704	2660	2615	2572	2528	2485	34
35	2982	2935	2887	2841	2795	2749	2704	2659	2615	2571	2527	2485	35
36	2981	2934	2887	2840	2794	2748	2703	2658	2614	2570	2527	2484	36
37	2981	2933	2886	2839	2793	2747	2702	2657	2613	2569	2526	2483	37
38	2980	2932	2885	2838	2792	2747	2701	2657	2612	2569	2525	2482	38
39	2979	2931	2884	2838	2792	2746	2701	2656	2612	2568	2525	2482	39
40	2978	2931	2883	2837	2791	2745	2700	2655	2611	2567	2524	2481	40
41	2977	2930	2883	2836	2790	2744	2699	2655	2610	2566	2523	2480	41
42	2977	2929	2882	2835	2789	2744	2698	2654	2610	2566	2522	2480	42
43	2976	2928	2881	2835	2788	2743	2698	2653	2609	2565	2522	2479	43
44	2975	2927	2880	2834	2788	2742	2697	2652	2608	2564	2521	2478	44
45	2974	2927	2880	2833	2787	2741	2696	2652	2607	2564	2520	2477	45
46	2973	2926	2879	2832	2786	2741	2695	2651	2607	2563	2520	2477	46
47	2973	2925	2878	2831	2785	2740	2695	2650	2606	2562	2519	2476	47
48	2972	2924	2877	2831	2785	2739	2694	2649	2605	2561	2518	2475	48
49	2971	2924	2876	2830	2784	2738	2693	2649	2604	2561	2517	2475	49
50	2970	2923	2876	2829	2783	2738	2692	2648	2604	2560	2517	2474	50
51	2969	2922	2875	2828	2782	2737	2692	2647	2603	2559	2516	2473	51
52	2969	2921	2874	2828	2782	2736	2691	2646	2602	2559	2515	2472	52
53	2968	2920	2873	2827	2781	2735	2690	2646	2601	2558	2515	2472	53
54	2967	2920	2873	2826	2780	2735	2689	2645	2601	2557	2514	2471	54
55	2966	2919	2872	2825	2779	2734	2689	2644	2600	2556	2513	2470	55
56	2965	2918	2871	2825	2779	2733	2688	2643	2599	2556	2512	2470	56
57	2965	2917	2870	2824	2778	2732	2687	2643	2599	2555	2512	2469	57
58	2964	2916	2869	2823	2777	2732	2687	2642	2598	2554	2511	2468	58
59	2963	2916	2869	2822	2776	2731	2686	2641	2597	2553	2510	2467	59
″	1° 30′	1° 31′	1° 32′	1° 33′	1° 34′	1° 35′	1° 36′	1° 37′	1° 38′	1° 39′	1° 40′	1° 41′	″

TABLE 35.

PROPORTIONAL LOGARITHMS.

s ″	h m 1° 42′	h m 1° 43′	h m 1° 44′	h m 1° 45′	h m 1° 46′	h m 1° 47′	h m 1° 48′	h m 1° 49′	h m 1° 50′	h m 1° 51′	h m 1° 52′	h m 1° 53	s ″
0	2467	2424	2382	2341	2300	2259	2218	2178	2139	2099	2061	2022	0
1	2466	2424	2382	2340	2299	2258	2218	2178	2138	2099	2060	2021	1
2	2465	2423	2381	2339	2298	2258	2217	2177	2137	2098	2059	2021	2
3	2465	2422	2380	2339	2298	2257	2216	2176	2137	2098	2059	2020	3
4	2464	2422	2380	2338	2297	2256	2216	2176	2136	2097	2058	2019	4
5	2463	2421	2379	2337	2296	2256	2215	2175	2136	2096	2057	2019	5
6	2462	2420	2378	2337	2296	2255	2214	2174	2135	2096	2057	2018	6
7	2462	2419	2378	2336	2295	2254	2214	2174	2134	2095	2056	2017	7
8	2461	2419	2377	2335	2294	2253	2213	2173	2134	2094	2055	2017	8
9	2460	2418	2376	2335	2294	2253	2212	2172	2133	2094	2055	2016	9
10	2460	2417	2375	2334	2293	2252	2212	2172	2132	2093	2054	2016	10
11	2459	2417	2375	2333	2292	2251	2211	2171	2132	2092	2053	2015	11
12	2458	2416	2374	2333	2291	2251	2210	2170	2131	2092	2053	2014	12
13	2458	2415	2373	2332	2291	2250	2210	2170	2130	2091	2052	2014	13
14	2457	2415	2373	2331	2290	2249	2209	2169	2130	2090	2052	2013	14
15	2456	2414	2372	2331	2289	2249	2208	2169	2129	2090	2051	2012	15
16	2455	2413	2371	2330	2289	2248	2208	2168	2128	2089	2050	2012	16
17	2455	2412	2371	2329	2288	2247	2207	2167	2128	2088	2050	2011	17
18	2454	2412	2370	2328	2287	2247	2206	2167	2127	2088	2049	2010	18
19	2453	2411	2369	2328	2287	2246	2206	2166	2126	2087	2048	2010	19
20	2453	2410	2368	2327	2286	2245	2205	2165	2126	2086	2048	2009	20
21	2452	2410	2368	2326	2285	2245	2204	2165	2125	2086	2047	2009	21
22	2451	2409	2367	2326	2285	2244	2204	2164	2124	2085	2046	2008	22
23	2450	2408	2366	2325	2284	2243	2203	2163	2124	2085	2046	2007	23
24	2450	2408	2366	2324	2283	2243	2202	2163	2123	2084	2045	2007	24
25	2449	2407	2365	2324	2283	2242	2202	2162	2122	2083	2044	2006	25
26	2448	2406	2364	2323	2282	2241	2201	2161	2122	2083	2044	2005	26
27	2448	2405	2364	2322	2281	2241	2200	2161	2121	2082	2043	2005	27
28	2447	2405	2363	2322	2281	2240	2200	2160	2120	2081	2042	2004	28
29	2446	2404	2362	2321	2280	2239	2199	2159	2120	2081	2042	2004	29
30	2445	2403	2362	2320	2279	2239	2198	2159	2119	2080	2041	2003	30
31	2445	2403	2361	2320	2279	2238	2198	2158	2118	2079	2041	2002	31
32	2444	2402	2360	2319	2278	2237	2197	2157	2118	2079	2040	2001	32
33	2443	2401	2359	2318	2277	2237	2196	2157	2117	2078	2039	2001	33
34	2443	2401	2359	2317	2277	2236	2196	2156	2116	2077	2039	2000	34
35	2442	2400	2358	2317	2276	2235	2195	2155	2116	2077	2038	2000	35
36	2441	2399	2357	2316	2275	2235	2194	2155	2115	2076	2037	1999	36
37	2441	2398	2357	2315	2274	2234	2194	2154	2115	2075	2037	1998	37
38	2440	2398	2356	2315	2274	2233	2193	2153	2114	2075	2036	1998	38
39	2439	2397	2355	2314	2273	2233	2192	2153	2113	2074	2035	1997	39
40	2438	2396	2355	2313	2272	2232	2192	2152	2113	2073	2035	1996	40
41	2438	2396	2354	2313	2272	2231	2191	2151	2112	2073	2034	1996	41
42	2437	2395	2353	2312	2271	2231	2190	2151	2111	2072	2033	1995	42
43	2436	2394	2353	2311	2270	2230	2190	2150	2111	2072	2033	1994	43
44	2436	2394	2352	2311	2270	2229	2189	2149	2110	2071	2032	1994	44
45	2435	2393	2351	2310	2269	2229	2188	2149	2109	2070	2032	1993	45
46	2434	2392	2350	2309	2268	2228	2188	2148	2109	2070	2031	1993	46
47	2433	2391	2350	2309	2268	2227	2187	2147	2108	2069	2030	1992	47
48	2433	2391	2349	2308	2267	2227	2186	2147	2107	2068	2030	1991	48
49	2432	2390	2348	2307	2266	2226	2186	2146	2107	2068	2029	1991	49
50	2431	2389	2348	2307	2266	2225	2185	2145	2106	2067	2028	1990	50
51	2431	2389	2347	2306	2265	2225	2184	2145	2105	2066	2028	1989	51
52	2430	2388	2346	2305	2264	2224	2184	2144	2105	2066	2027	1989	52
53	2429	2387	2346	2304	2264	2223	2183	2143	2104	2065	2026	1988	53
54	2429	2387	2345	2304	2263	2223	2182	2143	2103	2064	2026	1987	54
55	2428	2386	2344	2303	2262	2222	2182	2142	2103	2064	2025	1987	55
56	2427	2385	2344	2302	2262	2222	2181	2141	2102	2063	2025	1986	56
57	2426	2384	2343	2302	2261	2221	2180	2141	2101	2062	2024	1986	57
58	2426	2384	2342	2301	2260	2220	2180	2140	2101	2062	2023	1985	58
59	2425	2383	2342	2300	2260	2219	2179	2139	2100	2061	2023	1984	59
″	1° 42′	1° 43′	1° 44′	1° 45′	1° 46′	1° 47′	1° 48′	1° 49′	1° 50′	1° 51′	1°52′	1° 53′	s

TABLE 35.

PROPORTIONAL LOGARITHMS.

s ″	h m 1° 54′	h m 1° 55′	h m 1° 56′	h m 1° 57′	h m 1° 58′	h m 1° 59′	h m 2° 0′	h m 2° 1′	h m 2° 2′	h m 2° 3′	h m 2° 4	s ″
0	1984	1946	1908	1871	1834	1797	1761	1725	1689	1654	1619	0
1	1983	1945	1908	1870	1833	1797	1760	1724	1689	1653	1618	1
2	1982	1944	1907	1870	1833	1796	1760	1724	1688	1652	1617	2
3	1982	1944	1906	1869	1832	1795	1759	1723	1687	1652	1617	3
4	1981	1943	1906	1868	1831	1795	1759	1722	1687	1651	1616	4
5	1981	1943	1905	1868	1831	1794	1758	1722	1686	1651	1616	5
6	1980	1942	1904	1867	1830	1794	1757	1721	1686	1650	1615	6
7	1979	1941	1904	1867	1830	1793	1757	1721	1685	1650	1614	7
8	1979	1941	1903	1866	1829	1792	1756	1720	1684	1649	1614	8
9	1978	1940	1903	1865	1828	1792	1755	1719	1684	1648	1613	9
10	1977	1939	1902	1865	1828	1791	1755	1719	1683	1648	1613	10
11	1977	1939	1901	1864	1827	1791	1754	1718	1683	1647	1612	11
12	1976	1938	1901	1863	1827	1790	1754	1718	1682	1647	1612	12
13	1975	1938	1900	1863	1826	1789	1753	1717	1681	1646	1611	13
14	1975	1937	1899	1862	1825	1789	1752	1717	1681	1645	1610	14
15	1974	1936	1899	1862	1825	1788	1752	1716	1680	1645	1610	15
16	1974	1936	1898	1861	1824	1788	1751	1715	1680	1644	1609	16
17	1973	1935	1898	1860	1823	1787	1751	1715	1679	1644	1609	17
18	1972	1934	1897	1860	1823	1786	1750	1714	1678	1643	1608	18
19	1972	1934	1896	1859	1822	1786	1749	1714	1678	1643	1607	19
20	1971	1933	1896	1859	1822	1785	1749	1713	1677	1642	1607	20
21	1970	1933	1895	1858	1821	1785	1748	1712	1677	1641	1606	21
22	1970	1932	1894	1857	1820	1784	1748	1712	1676	1641	1606	22
23	1969	1931	1894	1857	1820	1783	1747	1711	1676	1640	1605	23
24	1968	1931	1893	1856	1819	1783	1746	1711	1675	1640	1605	24
25	1968	1930	1893	1855	1819	1782	1746	1710	1674	1639	1604	25
26	1967	1929	1892	1855	1818	1781	1745	1709	1674	1638	1603	26
27	1967	1929	1891	1854	1817	1781	1745	1709	1673	1638	1603	27
28	1966	1928	1891	1854	1817	1780	1744	1708	1673	1637	1602	28
29	1965	1928	1890	1853	1816	1780	1743	1708	1672	1637	1602	29
30	1965	1927	1889	1852	1816	1779	1743	1707	1671	1636	1601	30
31	1964	1926	1889	1852	1815	1778	1742	1706	1671	1635	1600	31
32	1963	1926	1888	1851	1814	1778	1742	1706	1670	1635	1600	32
33	1963	1925	1888	1850	1814	1777	1741	1705	1670	1634	1599	33
34	1962	1924	1887	1850	1813	1777	1740	1705	1669	1634	1599	34
35	1962	1924	1886	1849	1812	1776	1740	1704	1668	1633	1598	35
36	1961	1923	1886	1849	1812	1775	1739	1703	1668	1633	1598	36
37	1960	1923	1885	1848	1811	1775	1739	1703	1667	1632	1597	37
38	1960	1922	1884	1847	1811	1774	1738	1702	1667	1631	1596	38
39	1959	1921	1884	1847	1810	1774	1737	1702	1666	1631	1596	39
40	1958	1921	1883	1846	1809	1773	1737	1701	1665	1630	1595	40
41	1958	1920	1883	1846	1809	1772	1736	1700	1665	1630	1595	41
42	1957	1919	1882	1845	1808	1772	1736	1700	1664	1629	1594	42
43	1956	1919	1881	1844	1808	1771	1735	1699	1664	1628	1593	43
44	1956	1918	1881	1844	1807	1771	1734	1699	1663	1628	1593	44
45	1955	1918	1880	1843	1806	1770	1734	1698	1663	1627	1592	45
46	1955	1917	1880	1843	1806	1769	1733	1697	1662	1627	1592	46
47	1954	1916	1879	1842	1805	1769	1733	1697	1661	1626	1591	47
48	1953	1916	1878	1841	1805	1768	1732	1696	1661	1626	1591	48
49	1953	1915	1878	1841	1804	1768	1731	1696	1660	1625	1590	49
50	1952	1914	1877	1840	1803	1767	1731	1695	1660	1624	1589	50
51	1951	1914	1876	1839	1803	1766	1730	1694	1659	1624	1589	51
52	1951	1913	1876	1839	1802	1766	1730	1694	1658	1623	1588	52
53	1950	1913	1875	1838	1802	1765	1729	1693	1658	1623	1588	53
54	1950	1912	1875	1838	1801	1765	1728	1693	1657	1622	1587	54
55	1949	1911	1874	1837	1800	1764	1728	1692	1657	1621	1587	55
56	1948	1911	1873	1836	1800	1763	1727	1692	1656	1621	1586	56
57	1948	1910	1873	1836	1799	1763	1727	1691	1655	1620	1585	57
58	1947	1909	1872	1835	1798	1762	1726	1690	1655	1620	1585	58
59	1946	1909	1871	1835	1798	1762	1725	1690	1654	1619	1584	59
″	1° 54′	1° 55′	1° 56′	1° 57′	1° 58′	1° 59′	2° 0′	2° 1′	2° 2′	2° 3′	2° 4′	″

TABLE 35.

PROPORTIONAL LOGARITHMS.

s ″	h m 2° 5′	h m 2° 6′	h m 2° 7′	h m 2° 8′	h m 2° 9′	h m 2° 10′	h m 2° 11′	h m 2° 12′	h m 2° 13′	h m 2° 14′	h m 2° 15′	s ″
0	1584	1549	1515	1481	1447	1413	1380	1347	1314	1282	1249	0
1	1583	1548	1514	1480	1446	1413	1379	1346	1314	1281	1249	1
2	1582	1548	1514	1479	1446	1412	1379	1346	1313	1281	1248	2
3	1582	1547	1513	1479	1445	1412	1378	1345	1313	1280	1248	3
4	1581	1547	1512	1478	1445	1411	1378	1345	1312	1280	1247	4
5	1581	1546	1512	1478	1444	1411	1377	1344	1311	1279	1247	5
6	1580	1546	1511	1477	1443	1410	1377	1344	1311	1278	1246	6
7	1580	1545	1511	1477	1443	1409	1376	1343	1310	1278	1246	7
8	1579	1544	1510	1476	1442	1409	1376	1343	1310	1277	1245	8
9	1578	1544	1510	1476	1442	1408	1375	1342	1309	1277	1245	9
10	1578	1543	1509	1475	1441	1408	1374	1342	1309	1276	1244	10
11	1577	1543	1508	1474	1441	1407	1374	1341	1308	1276	1243	11
12	1577	1542	1508	1474	1440	1407	1373	1340	1308	1275	1243	12
13	1576	1542	1507	1473	1440	1406	1373	1340	1307	1275	1242	13
14	1576	1541	1507	1473	1439	1406	1372	1339	1307	1274	1242	14
15	1575	1540	1506	1472	1438	1405	1372	1339	1306	1274	1241	15
16	1574	1540	1506	1472	1438	1404	1371	1338	1306	1273	1241	16
17	1574	1539	1505	1471	1437	1404	1371	1338	1305	1273	1240	17
18	1573	1539	1504	1470	1437	1403	1370	1337	1304	1272	1240	18
19	1573	1538	1504	1470	1436	1403	1370	1337	1304	1271	1239	19
20	1572	1538	1503	1469	1436	1402	1369	1336	1303	1271	1239	20
21	1571	1537	1503	1469	1435	1402	1368	1335	1303	1270	1238	21
22	1571	1536	1502	1468	1435	1401	1368	1335	1302	1270	1238	22
23	1570	1536	1502	1468	1434	1401	1367	1334	1302	1269	1237	23
24	1570	1535	1501	1467	1433	1400	1367	1334	1301	1269	1237	24
25	1569	1535	1500	1467	1433	1399	1366	1333	1301	1268	1236	25
26	1569	1534	1500	1466	1432	1399	1366	1333	1300	1268	1235	26
27	1568	1534	1499	1465	1432	1398	1365	1332	1300	1267	1235	27
28	1567	1533	1499	1465	1431	1398	1365	1332	1299	1267	1234	28
29	1567	1532	1498	1464	1431	1397	1364	1331	1298	1266	1234	29
30	1566	1532	1498	1464	1430	1397	1363	1331	1298	1266	1233	30
31	1566	1531	1497	1463	1429	1396	1363	1330	1297	1265	1233	31
32	1565	1531	1496	1463	1429	1396	1362	1329	1297	1264	1232	32
33	1565	1530	1496	1462	1428	1395	1362	1329	1296	1264	1232	33
34	1564	1530	1495	1461	1428	1394	1361	1328	1296	1263	1231	34
35	1563	1529	1495	1461	1427	1394	1361	1328	1295	1263	1231	35
36	1563	1528	1494	1460	1427	1393	1360	1327	1295	1262	1230	36
37	1562	1528	1494	1460	1426	1393	1360	1327	1294	1262	1230	37
38	1562	1527	1493	1459	1426	1392	1359	1326	1294	1261	1229	38
39	1561	1527	1493	1459	1425	1392	1359	1326	1293	1261	1229	39
40	1561	1526	1492	1458	1424	1391	1358	1325	1292	1260	1228	40
41	1560	1526	1491	1458	1424	1391	1357	1325	1292	1260	1227	41
42	1559	1525	1491	1457	1423	1390	1357	1324	1291	1259	1227	42
43	1559	1524	1490	1456	1423	1389	1356	1323	1291	1259	1226	43
44	1558	1524	1490	1456	1422	1389	1356	1323	1290	1258	1226	44
45	1558	1523	1489	1455	1422	1388	1355	1322	1290	1257	1225	45
46	1557	1523	1489	1455	1421	1388	1355	1322	1289	1257	1225	46
47	1556	1522	1488	1454	1421	1387	1354	1321	1289	1256	1224	47
48	1556	1522	1487	1454	1420	1387	1354	1321	1288	1256	1224	48
49	1555	1521	1487	1453	1419	1386	1353	1320	1288	1255	1223	49
50	1555	1520	1486	1452	1419	1386	1352	1320	1287	1255	1223	50
51	1554	1520	1486	1452	1418	1385	1352	1319	1287	1254	1222	51
52	1554	1519	1485	1451	1418	1384	1351	1319	1286	1254	1222	52
53	1553	1519	1485	1451	1417	1384	1351	1318	1285	1253	1221	53
54	1552	1518	1484	1450	1417	1383	1350	1317	1285	1253	1221	54
55	1552	1518	1483	1450	1416	1383	1350	1317	1284	1252	1220	55
56	1551	1517	1483	1449	1416	1382	1349	1316	1284	1252	1219	56
57	1551	1516	1482	1449	1415	1382	1349	1316	1283	1251	1219	57
58	1550	1516	1482	1448	1414	1381	1348	1315	1282	1250	1218	58
59	1550	1515	1481	1447	1414	1381	1348	1315	1282	1250	1218	59
″	2° 5′	2° 6′	2° 7′	2° 8′	2° 9′	2° 10′	2° 11′	2° 12′	2° 13′	2° 14′	2° 15′	″

TABLE 35.

PROPORTIONAL LOGARITHMS.

s ″	h m 2° 16′	h m 2° 17′	h m 2° 18′	h m 2° 19′	h m 2° 20′	h m 2° 21′	h m 2° 22′	h m 2° 23′	h m 2° 24′	h m 2° 25′	h m 2° 26′	s ″
0	1217	1186	1154	1123	1091	1061	1030	0999	0969	0939	0909	0
1	1217	1185	1153	1122	1091	1060	1029	0999	0969	0939	0909	1
2	1216	1184	1153	1122	1090	1060	1029	0998	0968	0938	0908	2
3	1216	1184	1152	1121	1090	1059	1028	0998	0968	0938	0908	3
4	1215	1183	1152	1120	1089	1058	1028	0997	0967	0937	0907	4
5	1215	1183	1151	1120	1089	1058	1027	0997	0967	0937	0907	5
6	1214	1182	1151	1119	1088	1057	1027	0996	0966	0936	0906	6
7	1214	1182	1150	1119	1088	1057	1026	0996	0966	0936	0906	7
8	1213	1181	1150	1118	1087	1056	1026	0995	0965	0935	0905	8
9	1213	1181	1149	1118	1087	1056	1025	0995	0965	0935	0905	9
10	1212	1180	1149	1117	1086	1055	1025	0994	0964	0934	0904	10
11	1211	1180	1148	1117	1086	1055	1024	0994	0964	0934	0904	11
12	1211	1179	1148	1116	1085	1054	1024	0993	0963	0933	0903	12
13	1210	1179	1147	1116	1085	1054	1023	0993	0963	0933	0903	13
14	1210	1178	1147	1115	1084	1053	1023	0992	0962	0932	0902	14
15	1209	1178	1146	1115	1084	1053	1022	0992	0962	0932	0902	15
16	1209	1177	1146	1114	1083	1052	1022	0991	0961	0931	0901	16
17	1208	1177	1145	1114	1083	1052	1021	0991	0961	0931	0901	17
18	1208	1176	1145	1113	1082	1051	1021	0990	0960	0930	0900	18
19	1207	1175	1144	1113	1082	1051	1020	0990	0960	0930	0900	19
20	1207	1175	1143	1112	1081	1050	1020	0989	0959	0929	0899	20
21	1206	1174	1143	1112	1081	1050	1019	0989	0959	0929	0899	21
22	1206	1174	1142	1111	1080	1049	1019	0988	0958	0928	0898	22
23	1205	1173	1142	1111	1080	1049	1018	0988	0958	0928	0898	23
24	1205	1173	1141	1110	1079	1048	1018	0987	0957	0927	0897	24
25	1204	1172	1141	1110	1079	1048	1017	0987	0957	0927	0897	25
26	1204	1172	1140	1109	1078	1047	1017	0986	0956	0926	0896	26
27	1203	1171	1140	1109	1078	1047	1016	0986	0956	0926	0896	27
28	1202	1171	1139	1108	1077	1046	1016	0985	0955	0925	0895	28
29	1202	1170	1139	1108	1076	1046	1015	0985	0955	0925	0895	29
30	1201	1170	1138	1107	1076	1045	1015	0984	0954	0924	0894	30
31	1201	1169	1138	1106	1075	1045	1014	0984	0954	0924	0894	31
32	1200	1169	1137	1106	1075	1044	1014	0983	0953	0923	0893	32
33	1200	1168	1137	1105	1074	1044	1013	0983	0953	0923	0893	33
34	1199	1168	1136	1105	1074	1043	1013	0982	0952	0922	0892	34
35	1199	1167	1136	1104	1073	1043	1012	0982	0952	0922	0892	35
36	1198	1167	1135	1104	1073	1042	1012	0981	0951	0921	0891	36
37	1198	1166	1135	1103	1072	1042	1011	0981	0951	0921	0891	37
38	1197	1165	1134	1103	1072	1041	1011	0980	0950	0920	0890	38
39	1197	1165	1134	1102	1071	1041	1010	0980	0950	0920	0890	39
40	1196	1164	1133	1102	1071	1040	1009	0979	0949	0919	0889	40
41	1196	1164	1132	1101	1070	1040	1009	0979	0949	0919	0889	41
42	1195	1163	1132	1101	1070	1039	1008	0978	0948	0918	0888	42
43	1195	1163	1131	1100	1069	1039	1008	0978	0948	0918	0888	43
44	1194	1162	1131	1100	1069	1038	1007	0977	0947	0917	0887	44
45	1193	1162	1130	1099	1068	1037	1007	0977	0947	0917	0887	45
46	1193	1161	1130	1099	1068	1037	1006	0976	0946	0916	0886	46
47	1192	1161	1129	1098	1067	1086	1006	0976	0946	0916	0886	47
48	1192	1160	1129	1098	1067	1036	1005	0975	0945	0915	0885	48
49	1191	1160	1128	1097	1066	1035	1005	0975	0945	0915	0885	49
50	1191	1159	1128	1097	1066	1035	1004	0974	0944	0914	0884	50
51	1190	1159	1127	1096	1065	1034	1004	0974	0944	0914	0884	51
52	1190	1158	1127	1096	1065	1034	1003	0973	0943	0913	0883	52
53	1189	1158	1126	1095	1064	1033	1003	0973	0943	0913	0883	53
54	1189	1157	1126	1095	1064	1033	1002	0972	0942	0912	0883	54
55	1188	1157	1125	1094	1063	1032	1002	0972	0942	0912	0882	55
56	1188	1156	1125	1094	1063	1032	1001	0971	0941	0911	0882	56
57	1187	1156	1124	1093	1062	1031	1001	0971	0941	0911	0881	57
58	1187	1155	1124	1092	1062	1031	1000	0970	0940	0910	0881	58
59	1186	1154	1123	1092	1061	1030	1000	0970	0940	0910	0880	59
″	2° 16′	2° 17′	2° 18′	2° 19′	2° 20	2° 21′	2° 22′	2° 23′	2° 24′	2° 25′	2° 26′	″

TABLE 35.

PROPORTIONAL LOGARITHMS.

s ″	h m 2° 27′	h m 2° 28′	h m 2° 29′	h m 2° 30′	h m 2° 31′	h m 2° 32′	h m 2° 33′	h m 2° 34′	h m 2° 35′	h m 2° 36′	h m 2° 37′	s. ″
0	0880	0850	0821	0792	0763	0734	0706	0678	0649	0621	0594	0
1	0879	0850	0820	0791	0762	0734	0705	0677	0649	0621	0593	1
2	0879	0849	0820	0791	0762	0733	0705	0677	0648	0621	0593	2
3	0878	0849	0819	0790	0762	0733	0704	0676	0648	0620	0592	3
4	0878	0848	0819	0790	0761	0732	0704	0676	0648	0620	0592	4
5	0877	0848	0818	0789	0761	0732	0703	0675	0647	0619	0591	5
6	0877	0847	0818	0789	0760	0731	0703	0675	0647	0619	0591	6
7	0876	0847	0817	0788	0760	0731	0703	0674	0646	0618	0591	7
8	0876	0846	0817	0788	0759	0730	0702	0674	0646	0618	0590	8
9	0875	0846	0816	0787	0759	0730	0702	0673	0645	0617	0590	9
10	0875	0845	0816	0787	0758	0730	0701	0673	0645	0617	0589	10
11	0874	0845	0816	0787	0758	0729	0701	0672	0644	0616	0589	11
12	0874	0844	0815	0786	0757	0729	0700	0672	0644	0616	0588	12
13	0873	0844	0815	0786	0757	0728	0700	0671	0643	0615	0588	13
14	0873	0843	0814	0785	0756	0728	0699	0671	0643	0615	0587	14
15	0872	0843	0814	0785	0756	0727	0699	0670	0642	0615	0587	15
16	0872	0842	0813	0784	0755	0727	0698	0670	0642	0614	0586	16
17	0871	0842	0813	0784	0755	0726	0698	0670	0641	0614	0586	17
18	0871	0841	0812	0783	0754	0726	0697	0669	0641	0613	0585	18
19	0870	0841	0812	0783	0754	0725	0697	0669	0641	0613	0585	19
20	0870	0840	0811	0782	0753	0725	0696	0668	0640	0612	0585	20
21	0869	0840	0811	0782	0753	0724	0696	0668	0640	0612	0584	21
22	0869	0839	0810	0781	0752	0724	0695	0667	0639	0611	0584	22
23	0868	0839	0810	0781	0752	0723	0695	0667	0639	0611	0583	23
24	0868	0838	0809	0780	0751	0723	0695	0666	0638	0610	0583	24
25	0867	0838	0809	0780	0751	0722	0694	0666	0638	0610	0582	25
26	0867	0837	0808	0779	0751	0722	0694	0665	0637	0609	0582	26
27	0866	0837	0808	0779	0750	0721	0693	0665	0637	0609	0581	27
28	0866	0836	0807	0778	0750	0721	0693	0664	0636	0609	0581	28
29	0865	0836	0807	0778	0749	0721	0692	0664	0636	0608	0580	29
30	0865	0835	0806	0777	0749	0720	0692	0663	0635	0608	0580	30
31	0864	0835	0806	0777	0748	0720	0691	0663	0635	0607	0579	31
32	0864	0834	0805	0776	0748	0719	0691	0663	0634	0607	0579	32
33	0863	0834	0805	0776	0747	0719	0690	0662	0634	0606	0579	33
34	0863	0834	0804	0775	0747	0718	0690	0662	0634	0606	0578	34
35	0862	0833	0804	0775	0746	0718	0689	0661	0633	0605	0578	35
36	0862	0833	0803	0774	0746	0717	0689	0661	0633	0605	0577	36
37	0861	0832	0803	0774	0745	0717	0688	0660	0632	0604	0577	37
38	0861	0832	0802	0774	0745	0716	0688	0660	0632	0604	0576	38
39	0860	0831	0802	0773	0744	0716	0687	0659	0631	0603	0576	39
40	0860	0831	0801	0773	0744	0715	0687	0659	0631	0603	0575	40
41	0859	0830	0801	0772	0743	0715	0686	0658	0630	0602	0575	41
42	0859	0830	0801	0772	0743	0714	0686	0658	0630	0602	0574	42
43	0858	0829	0800	0771	0742	0714	0686	0657	0629	0602	0574	43
44	0858	0829	0800	0771	0742	0713	0685	0657	0629	0601	0573	44
45	0857	0828	0799	0770	0741	0713	0685	0656	0628	0601	0573	45
46	0857	0828	0799	0770	0741	0712	0684	0656	0628	0600	0573	46
47	0856	0827	0798	0769	0740	0712	0684	0655	0628	0600	0572	47
48	0856	0827	0798	0769	0740	0711	0683	0655	0627	0599	0572	48
49	0855	0826	0797	0768	0740	0711	0683	0655	0627	0599	0571	49
50	0855	0826	0797	0768	0739	0711	0682	0654	0626	0598	0571	50
51	0855	0825	0796	0767	0739	0710	0682	0654	0626	0598	0570	51
52	0854	0825	0796	0767	0738	0710	0681	0653	0625	0597	0570	52
53	0854	0824	0795	0766	0738	0709	0681	0653	0625	0597	0569	53
54	0853	0824	0795	0766	0737	0709	0680	0652	0624	0596	0569	54
55	0853	0823	0794	0765	0737	0708	0680	0652	0624	0596	0568	55
56	0852	0823	0794	0765	0736	0708	0679	0651	0623	0596	0568	56
57	0852	0822	0793	0764	0736	0707	0679	0651	0623	0595	0568	57
58	0851	0822	0793	0764	0735	0707	0678	0650	0622	0595	0567	58
59	0851	0821	0792	0763	0735	0706	0678	0650	0622	0594	0567	59
″	2° 27′	2° 28′	2° 29′	2° 30′	2° 31′	2° 32′	2° 33′	2° 34′	2° 35′	2° 36′	2° 37′	″

Proportional Logarithms.

s ″	h m 2° 38′	h m 2° 39′	h m 2° 40′	h m 2° 41′	h m 2° 42′	h m 2° 43′	h m 2° 44′	h m 2° 45′	h m 2° 46′	h m 2° 47′	h m 2° 48′	s ″
0	0566	0539	0512	0484	0458	0431	0404	0378	0352	0326	0300	0
1	0566	0538	0511	0484	0457	0430	0404	0377	0351	0325	0299	1
2	0565	0538	0511	0484	0457	0430	0403	0377	0351	0325	0299	2
3	0565	0537	0510	0483	0456	0430	0403	0377	0350	0324	0298	3
4	0564	0537	0510	0483	0456	0429	0403	0376	0350	0324	0298	4
5	0564	0536	0509	0482	0455	0429	0402	0376	0349	0323	0297	5
6	0563	0536	0509	0482	0455	0428	0402	0375	0349	0323	0297	6
7	0563	0536	0508	0481	0454	0428	0401	0375	0349	0323	0297	7
8	0562	0535	0508	0481	0454	0427	0401	0374	0348	0322	0296	8
9	0562	0535	0507	0480	0454	0427	0400	0374	0348	0322	0296	9
10	0562	0534	0507	0480	0453	0426	0400	0374	0347	0321	0295	10
11	0561	0534	0507	0480	0453	0426	0399	0373	0347	0321	0295	11
12	0561	0533	0506	0479	0452	0426	0399	0373	0346	0320	0294	12
13	0560	0533	0506	0479	0452	0425	0399	0372	0346	0320	0294	13
14	0560	0532	0505	0478	0451	0425	0398	0372	0346	0319	0294	14
15	0559	0532	0505	0478	0451	0424	0398	0371	0345	0319	0293	15
16	0559	0531	0504	0477	0450	0424	0397	0371	0345	0319	0293	16
17	0558	0531	0504	0477	0450	0423	0397	0370	0344	0318	0292	17
18	0558	0531	0503	0476	0450	0423	0396	0370	0344	0318	0292	18
19	0557	0530	0503	0476	0449	0422	0396	0370	0343	0317	0291	19
20	0557	0530	0502	0475	0449	0422	0395	0369	0343	0317	0291	20
21	0557	0529	0502	0475	0448	0422	0395	0369	0342	0316	0291	21
22	0556	0529	0502	0475	0448	0421	0395	0368	0342	0316	0290	22
23	0556	0528	0501	0474	0447	0421	0394	0368	0342	0316	0290	23
24	0555	0528	0501	0474	0447	0420	0394	0367	0341	0315	0289	24
25	0555	0527	0500	0473	0446	0420	0393	0367	0341	0315	0289	25
26	0554	0527	0500	0473	0446	0419	0393	0366	0340	0314	0288	26
27	0554	0526	0499	0472	0446	0419	0392	0366	0340	0314	0288	27
28	0553	0526	0499	0472	0445	0418	0392	0366	0339	0313	0288	28
29	0553	0526	0498	0471	0445	0418	0391	0365	0339	0313	0287	29
30	0552	0525	0498	0471	0444	0418	0391	0365	0339	0313	0287	30
31	0552	0525	0498	0471	0444	0417	0391	0364	0338	0312	0286	31
32	0552	0524	0497	0470	0443	0417	0390	0364	0338	0312	0286	32
33	0551	0524	0497	0470	0443	0416	0390	0363	0337	0311	0285	33
34	0551	0523	0496	0469	0442	0416	0389	0363	0337	0311	0285	34
35	0550	0523	0496	0469	0442	0415	0389	0363	0336	0310	0285	35
36	0550	0522	0495	0468	0442	0415	0388	0362	0336	0310	0284	36
37	0549	0522	0495	0468	0441	0414	0388	0362	0336	0310	0284	37
38	0549	0521	0494	0467	0441	0414	0388	0361	0335	0309	0283	38
39	0548	0521	0494	0467	0440	0414	0387	0361	0335	0309	0283	39
40	0548	0521	0493	0467	0440	0413	0387	0360	0334	0308	0282	40
41	0547	0520	0493	0466	0439	0413	0386	0360	0334	0308	0282	41
42	0547	0520	0493	0466	0439	0412	0386	0359	0333	0307	0282	42
43	0546	0519	0492	0465	0438	0412	0385	0359	0333	0307	0281	43
44	0546	0519	0492	0465	0438	0411	0385	0359	0333	0307	0281	44
45	0546	0518	0491	0464	0438	0411	0384	0358	0332	0306	0280	45
46	0545	0518	0491	0464	0437	0410	0384	0358	0332	0306	0280	46
47	0545	0517	0490	0463	0437	0410	0384	0357	0331	0305	0279	47
48	0544	0517	0490	0463	0436	0410	0383	0357	0331	0305	0279	48
49	0544	0517	0489	0462	0436	0409	0383	0356	0330	0304	0279	49
50	0543	0516	0489	0462	0435	0409	0382	0356	0330	0304	0278	50
51	0543	0516	0489	0462	0435	0408	0382	0356	0329	0304	0278	51
52	0542	0515	0488	0461	0434	0408	0381	0355	0329	0303	0277	52
53	0542	0515	0488	0461	0434	0407	0381	0355	0329	0303	0277	53
54	0541	0514	0487	0460	0434	0407	0381	0354	0328	0302	0276	54
55	0541	0514	0487	0460	0433	0406	0380	0354	0328	0302	0276	55
56	0541	0513	0486	0459	0433	0406	0380	0353	0327	0301	0276	56
57	0540	0513	0486	0459	0432	0406	0379	0353	0327	0301	0275	57
58	0540	0512	0485	0458	0432	0405	0379	0353	0326	0300	0275	58
59	0539	0512	0485	0458	0431	0405	0378	0352	0326	0300	0274	59
	2° 38′	2° 39′	2° 40′	2° 41′	2° 42′	2° 43′	2° 44′	2° 45′	2° 46′	2° 47′	2° 48′	″

TABLE 35.

PROPORTIONAL LOGARITHMS.

s ″	h m 2° 49′	h m 2° 50′	h m 2° 51′	h m 2° 52′	h m 2° 53′	h m 2° 54′	h m 2° 55′	h m 2° 56′	h m 2° 57′	h m 2° 58′	h m 2° 59′	s ″
0	0274	0248	0223	0197	0172	0147	0122	0098	0073	0049	0024	0
1	0273	0248	0222	0197	0172	0147	0122	0097	0073	0048	0024	1
2	0273	0247	0222	0197	0171	0146	0122	0097	0072	0048	0023	2
3	0273	0247	0221	0196	0171	0146	0121	0096	0072	0047	0023	3
4	0272	0247	0221	0196	0171	0146	0121	0096	0071	0047	0023	4
5	0272	0246	0221	0195	0170	0145	0120	0096	0071	0046	0022	5
6	0271	0246	0220	0195	0170	0145	0120	0095	0071	0046	0022	6
7	0271	0245	0220	0194	0169	0144	0119	0095	0070	0046	0021	7
8	0270	0245	0219	0194	0169	0144	0119	0094	0070	0045	0021	8
9	0270	0244	0219	0194	0169	0143	0119	0094	0069	0045	0021	9
10	0270	0244	0219	0193	0168	0143	0118	0093	0069	0044	0020	10
11	0269	0244	0218	0193	0168	0143	0118	0093	0068	0044	0020	11
12	0269	0243	0218	0192	0167	0142	0117	0093	0068	0044	0019	12
13	0268	0243	0217	0192	0167	0142	0117	0092	0068	0043	0019	13
14	0268	0242	0217	0192	0166	0141	0117	0092	0067	0043	0019	14
15	0267	0242	0216	0191	0166	0141	0116	0091	0067	0042	0018	15
16	0267	0241	0216	0191	0166	0141	0116	0091	0066	0042	0018	16
17	0267	0241	0216	0190	0165	0140	0115	0091	0066	0042	0017	17
18	0266	0241	0215	0190	0165	0140	0115	0090	0066	0041	0017	18
19	0266	0240	0215	0189	0164	0139	0114	0090	0065	0041	0017	19
20	0265	0240	0214	0189	0164	0139	0114	0089	0065	0040	0016	20
21	0265	0239	0214	0189	0163	0139	0114	0089	0064	0040	0016	21
22	0264	0239	0213	0188	0163	0138	0113	0089	0064	0040	0015	22
23	0264	0238	0213	0188	0163	0138	0113	0088	0064	0039	0015	23
24	0264	0238	0213	0187	0162	0137	0112	0088	0063	0039	0015	24
25	0263	0238	0212	0187	0162	0137	0112	0087	0063	0038	0014	25
26	0263	0237	0212	0187	0161	0136	0112	0087	0062	0038	0014	26
27	0262	0237	0211	0186	0161	0136	0111	0087	0062	0038	0013	27
28	0262	0236	0211	0186	0161	0136	0111	0086	0062	0037	0013	28
29	0261	0236	0211	0185	0160	0135	0110	0086	0061	0037	0012	29
30	0261	0235	0210	0185	0160	0135	0110	0085	0061	0036	0012	30
31	0261	0235	0210	0184	0159	0134	0110	0085	0060	0036	0012	31
32	0260	0235	0209	0184	0159	0134	0109	0084	0060	0036	0011	32
33	0260	0234	0209	0184	0158	0134	0109	0084	0060	0035	0011	33
34	0259	0234	0208	0183	0158	0133	0108	0084	0059	0035	0010	34
35	0259	0233	0208	0183	0158	0133	0108	0083	0059	0034	0010	35
36	0258	0233	0208	0182	0157	0132	0107	0083	0058	0034	0010	36
37	0258	0233	0207	0182	0157	0132	0107	0082	0058	0034	0009	37
38	0258	0232	0207	0181	0156	0131	0107	0082	0057	0033	0009	38
39	0257	0232	0206	0181	0156	0131	0106	0082	0057	0033	0008	39
40	0257	0231	0206	0181	0156	0131	0106	0081	0057	0032	0008	40
41	0256	0231	0205	0180	0155	0130	0105	0081	0056	0032	0008	41
42	0256	0230	0205	0180	0155	0130	0105	0080	0056	0031	0007	42
43	0255	0230	0205	0179	0154	0129	0105	0080	0055	0031	0007	43
44	0255	0230	0204	0179	0154	0129	0104	0080	0055	0031	0006	44
45	0255	0229	0204	0179	0153	0129	0104	0079	0055	0030	0006	45
46	0254	0229	0203	0178	0153	0128	0103	0079	0054	0030	0006	46
47	0254	0228	0203	0178	0153	0128	0103	0078	0054	0029	0005	47
48	0253	0228	0202	0177	0152	0127	0103	0078	0053	0029	0005	48
49	0253	0227	0202	0177	0152	0127	0102	0077	0053	0029	0004	49
50	0252	0227	0202	0176	0151	0126	0102	0077	0053	0028	0004	50
51	0252	0227	0201	0176	0151	0126	0101	0077	0052	0028	0004	51
52	0252	0226	0201	0176	0151	0126	0101	0076	0052	0027	0003	52
53	0251	0226	0200	0175	0150	0125	0100	0076	0051	0027	0003	53
54	0251	0225	0200	0175	0150	0125	0100	0075	0051	0027	0002	54
55	0250	0225	0200	0174	0149	0124	0100	0075	0051	0026	0002	55
56	0250	0224	0199	0174	0149	0124	0099	0075	0050	0026	0002	56
57	0250	0224	0199	0174	0148	0124	0099	0074	0050	0025	0001	57
58	0249	0224	0198	0173	0148	0123	0098	0074	0049	0025	0001	58
59	0249	0223	0198	0173	0148	0123	0098	0073	0049	0025	0000	59
″	2° 49′	2° 50′	2° 51′	2° 52′	2° 53′	2° 54′	2° 55′	2° 56′	2° 57′	2° 58′	2° 59′	″

TABLE 36.

APPARENT DISTANCE, 10°

Apparent Altitude of the Sun or Star.

☽'s Alt.	6°	7°	8°	9°	10°	11°	12°	14°	16°	18°	20°	22°	24°	26°	28°	30°	32°	☽'s Alt.
	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	
6°	2 49	2 48	2 55	3 6	3 23	3 45	3 59	4 35	5 9									6°
7	3 0	2 48	2 47	2 52	3 0	3 10	3 22	3 46	4 7									7
8	3 15	2 56	2 48	2 47	2 49	2 54	3 1	3 15	3 28	3 37								8
9	3 34	3 8	2 54	2 47	2 45	2 47	2 49	2 57	3 4	3 7								9
10	3 52	3 21	3 2	2 51	2 46	2 44	2 42	2 47	2 49	2 48	2 41							10
11	4 10	3 34	3 11	2 57	2 49	2 45	2 43	2 42	2 41	2 37	2 28							11
12	4 27	3 46	3 20	3 4	2 53	2 47	2 44	2 41	2 40	2 32	2 21	2 5						12
13	4 42	3 57	3 28	3 8	2 57	2 50	2 45	2 41	2 37	2 30	2 19	2 2						13
14	4 54	4 5	3 34	3 14	3 1	2 52	2 47	2 42	2 37	2 31	2 19	2 3	1 40					14
15	5 3	4 12	3 39	3 17	3 2	2 54	2 48	2 42	2 38	2 32	2 22	2 6	1 43					15
16	5 9	4 15	3 41	3 18	3 3	2 53	2 48	2 42	2 39	2 34	2 25	2 10	1 49	1 22				16
17		4 16	3 40	3 16	3 1	2 51	2 46	2 41	2 38	2 35	2 27	2 15	1 56	1 30				17
18			3 37	3 12	2 57	2 47	2 42	2 38	2 37	2 36	2 30	2 19	2 2	1 39	1 8			18
19				3 6	2 50	2 41	2 36	2 33	2 35	2 35	2 32	2 23	2 9	1 47	1 19			19
20					2 41	2 31	2 28	2 27	2 30	2 33	2 32	2 26	2 14	1 55	1 30	0 58		20
21						2 21	2 18	2 19	2 24	2 29	2 31	2 28	2 19	2 3	1 41	1 11		21
22							2 5	2 8	2 17	2 24	2 29	2 28	2 24	2 9	1 50	1 23	0 50	22
23								1 55	2 6	2 16	2 24	2 27	2 24	2 15	1 58	1 35	1 4	23
24								1 40	1 55	2 7	2 18	2 26	2 24	2 20	2 5	1 45	1 17	24
25									1 38	1 56	2 10	2 19	2 23	2 20	2 10	1 53	1 29	25
26									1 22	1 43	1 59	2 12	2 22	2 20	2 15	2 0	1 39	26
27										1 26	1 47	2 4	2 14	2 18	2 15	2 5	1 48	27
28										1 8	1 33	1 53	2 7	2 16	2 15	2 10	1 55	28
29											1 16	1 40	1 58	2 9	2 14	2 11	2 1	29
30											0 58	1 26	1 47	2 2	2 11	2 10	2 4	30
31												1 9	1 34	1 53	2 4	2 9	2 6	31
32												0 50	1 19	1 42	1 57	2 5	2 6	32
33													1 2	1 29	1 47	1 59	2 5	33
34													0 44	1 14	1 37	1 52	2 0	34
35														0 57	1 24	1 43	1 54	35
36														0 39	1 9	1 32	1 47	36
37															0 53	1 19	1 38	37
38															0 35	1 5	1 27	38
39																0 49	1 15	39
40																0 31	1 1	40
41																	0 45	41
42																	0 28	42
43																		43
44																		44
46																		46

TABLE 4 *a*.

Differences for One Minute ☾'s Horizontal Parallax.

Apparent Altitude of the Sun, Star or Planet.

☾'s Alt.	6°	10°	16°	20°	30°	40°	50°	62°	74°	86°	☽'s Alt.
	″	″	″	″	″	″	″	″	″	″	
6°	5·6	4·4	0								6°
10	4·9	5·5	3·3	0							10
15	1·1	4·2	5·2	3·8							15
20		0	4·3	5·0	0						20
25			0·9	3·6	3·3						25
30				0	4·2	0					30
35					3·0	2·6					35
40					0	3·3	0				40
50						0	2·3				50
60							0	1·2			60
70								0·3	0·4		70
80									0·2	0	80
86	Add for every min. ☾'s H.P. above 57. Subtract ,, ,, under 57.										86
	6°	10°	16°	20°	30°	40°	50°	62°	74°	86°	

TABLE 36.

APPARENT DISTANCE, 10°

Apparent Altitude of the Sun or Star.

's lt.	34°	36°	38°	40°	42°	44°	46°	50°	54°	58°	62°	66°	70°	74°	78°	82°	86°	D's Alt.
	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	
6°																		6°
7																		7
8																		8
9																		9
10																		10
11																		11
12																		12
13																		13
14																		14
15																		15
16																		16
17																		17
18																		18
19																		19
20																		20
21																		21
22																		22
23																		23
24	0 44																	24
25	0 59																	25
26	1 12	0 39																26
27	1 24	0 54																27
28	1 35	1 8	0 35															28
29	1 44	1 20	0 50															29
30	1 51	1 30	1 4	0 31														30
31	1 56	1 39	1 16	0 46														31
32	1 59	1 46	1 26	1 0	0 28													32
33	2 1	1 51	1 34	1 12	0 43													33
34	2 0	1 54	1 41	1 21	0 56	0 26												34
35	1 58	1 55	1 46	1 30	1 8	0 40												35
36	1 55	1 55	1 49	1 36	1 17	0 53	0 24											36
37	1 49	1 53	1 50	1 41	1 25	1 4	0 38											37
38	1 42	1 49	1 50	1 43	1 31	1 13	0 50											38
39	1 33	1 44	1 47	1 45	1 35	1 20	1 0											39
40	1 22	1 37	1 44	1 44	1 36	1 26	1 9	0 20										40
41	1 10	1 28	1 38	1 42	1 39	1 30	1 16	0 33										41
42	0 57	1 18	1 32	1 38	1 38	1 33	1 21	0 44										42
43	0 42	1 6	1 23	1 33	1 36	1 33	1 25	0 53										43
44	0 26	0 53	1 14	1 27	1 33	1 33	1 27	1 1	0 18									44
46		0 24	0 49	1 9	1 21	1 27	1 27	1 11	0 38									46
48			0 22	0 47	1 5	1 16	1 22	1 16	0 53	0 16								48
50				0 20	0 44	1 1	1 11	1 16	1 2	0 33								50
52					0 19	0 41	0 57	1 11	1 5	0 45	0 14							52
54						0 18	0 38	1 2	1 5	0 52	0 28							54
56							0 17	0 49	1 0	0 55	0 38	0 13						56
58								0 33	0 52	0 54	0 44	0 24						58
60								0 15	0 42	0 50	0 46	0 32	0 12					60
62									0 29	0 44	0 45	0 36	0 21					62
64									0 14	0 35	0 41	0 37	0 26	0 12				64
66										0 24	0 36	0 36	0 29	0 17				66
68										0 13	0 29	0 34	0 29	0 21	0 11			68
70											0 21	0 29	0 28	0 22	0 15			70
72											0 12	0 23	0 26	0 22	0 16	0 11		72
74												0 17	0 22	0 21	0 17	0 13		74
76												0 11	0 19	0 19	0 17	0 13	0 10	76
78													0 15	0 17	0 16	0 13	0 11	78
80													0 11	0 15	0 15	0 13	0 11	80
82														0 13	0 13	0 12	0 11	82
84														0 11	0 12	0 11	0 10	84
86															0 11	0 11		86

TABLE 36.

Apparent Distance, 12°

Apparent Altitude of the Sun or Star.

☽'s Alt.	6°	7°	8°	9°	10°	11°	12°	14°	16°	18°	20°	22°	24°	26°	28°	30°	32°	☾'s Alt.
	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	
6	2 24	2 23	2 30	2 43	2 58	3 16	3 35	4 15	4 54	5 32								6
7	2 33	2 23	2 23	2 28	2 36	2 48	3 1	3 29	3 57	4 25								7
8	2 48	2 30	2 23	2 22	2 25	2 32	2 40	2 59	3 19	3 39	3 56							8
9	3 5	2 41	2 28	2 22	2 21	2 23	2 28	2 40	2 54	3 7	3 18							9
10	3 24	2 54	2 36	2 26	2 22	2 20	2 22	2 28	2 38	2 46	2 53	2 57						10
11	3 44	3 8	2 46	2 33	2 25	2 21	2 20	2 19	2 27	2 32	2 35	2 36						11
12	4 2	3 23	2 57	2 40	2 29	2 23	2 20	2 19	2 21	2 23	2 24	2 23	2 18					12
13	4 21	3 37	3 7	2 48	2 35	2 26	2 22	2 18	2 17	2 18	2 17	2 14	2 7					13
14	4 38	3 50	3 18	2 56	2 40	2 27	2 24	2 18	2 16	2 15	2 13	2 8	2 2	1 51				14
15	4 54	4 2	3 27	3 3	2 46	2 35	2 27	2 19	2 15	2 13	2 10	2 6	1 58	1 47				15
16	5 9	4 13	3 35	3 9	2 51	2 38	2 29	2 20	2 16	2 13	2 10	2 4	1 57	1 46	1 31			16
17	5 21	4 23	3 42	3 14	2 54	2 41	2 31	2 21	2 16	2 13	2 9	2 4	1 57	1 46	1 32			17
18	5 32	4 31	3 48	3 19	2 57	2 43	2 33	2 21	2 16	2 13	2 10	2 5	1 58	1 47	1 35	1 17		18
19		4 37	3 53	3 21	2 59	2 44	2 33	2 21	2 15	2 13	2 10	2 6	1 59	1 50	1 37	1 21		19
20			3 56	3 23	3 0	2 44	2 32	2 20	2 15	2 12	2 10	2 7	2 1	1 52	1 40	1 25	1 6	20
21				3 23	2 59	2 42	2 31	2 18	2 13	2 11	2 10	2 7	2 2	1 54	1 43	1 29	1 11	21
22					2 57	2 39	2 28	2 15	2 10	2 9	2 9	2 7	2 3	1 57	1 47	1 34	1 17	22
23						2 35	2 23	2 11	2 7	2 6	2 7	2 6	2 4	1 58	1 50	1 38	1 23	23
24							2 18	2 5	2 2	2 2	2 4	2 5	2 3	2 0	1 52	1 42	1 28	24
25								1 59	1 56	1 58	2 0	2 2	2 2	2 0	1 54	1 45	1 33	25
26								1 51	1 49	1 52	1 56	1 59	2 1	2 0	1 56	1 48	1 37	26
27									1 41	1 45	1 50	1 55	1 58	1 59	1 56	1 50	1 41	27
28									1 31	1 37	1 43	1 50	1 55	1 57	1 56	1 52	1 44	28
29										1 27	1 35	1 43	1 50	1 54	1 55	1 52	1 46	29
30										1 17	1 27	1 36	1 44	1 50	1 53	1 52	1 48	30
31											1 17	1 28	1 38	1 45	1 50	1 51	1 48	31
32											1 6	1 19	1 30	1 39	1 46	1 48	1 48	32
33												1 8	1 22	1 33	1 41	1 45	1 46	33
34												0 57	1 12	1 25	1 35	1 41	1 44	34
35													1 1	1 16	1 28	1 36	1 41	35
36													0 50	1 6	1 20	1 30	1 37	36
37														0 56	1 11	1 23	1 32	37
38														0 44	1 2	1 16	1 26	38
39															0 51	1 7	1 19	39
40															0 40	0 57	1 11	40
41																0 47	1 3	41
42																0 36	0 54	42
43																	0 44	43
44																	0 33	44
46																		46

TABLE 4*a*

Differences for One Minute ☾'s Horizontal Parallax.

Apparent Altitude of the Sun or Star.

☾'s Alt.	6°	10°	16°	20°	30°	40°	50°	62°	74°	86°	☾'s Alt.
	″	″	″	″	″	″	″	″	″	″	
6°	4·6	3·9	1·3								6°
10	4·3	4·5	3·2	1·2							10
15	2·1	3·8	4·3	3·5							15
20		1·4	3·8	4·1	1·2						20
25			1·8	3·3	3.0						25
30				1·2	3·5	0·9					30
35					2·7	2·4					35
40					1·0	2·7	0·7				40
50						0·7	1·9	0			50
60							0·5	1·0			60
70								0·4	0·4		70
80									0. 1		80
86	Add for every min. ☾'s H. P. above 57. Subtract ,, ,, ,, under 57.									0	86
	6°	10°	16°	20°	30°	40°	50°	62°	74°	86°	

TABLE 36.

Apparent Distance, 12°

Apparent Altitude of the Sun or Star.

34° ′ ″	36° ′ ″	38° ′ ″	40° ′ ″	42° ′ ″	44° ′ ″	46° ′ ″	50° ′ ″	54° ′ ″	58° ′ ″	62° ′ ″	66° ′ ″	70° ′ ″	74° ′ ″	78° ′ ″	82° ′ ″	86° ′ ″	☽'s Alt.
																	6°
																	7
																	8
																	9
																	10
																	11
																	12
																	13
																	14
																	15
																	16
																	17
																	18
																	19
																	20
																	21
0 57																	22
1 4																	23
1 11	0 50																24
1 17	0 58																25
1 23	1 5	0 44															26
1 28	1 12	0 53															27
1 33	1 18	1 1	0 40														28
1 37	1 24	1 8	0 49														29
1 40	1 29	1 14	0 57	0 36													30
1 42	1 33	1 20	1 4	0 45													31
1 44	1 36	1 25	1 10	0 53	0 33												32
1 44	1 38	1 29	1 16	1 0	0 41												33
1 44	1 39	1 32	1 21	1 6	0 49	0 30											34
1 42	1 40	1 34	1 24	1 12	0 57	0 39											35
1 40	1 39	1 35	1 27	1 16	1 3	0 46											36
1 37	1 38	1 35	1 29	1 20	1 8	0 53											37
1 32	1 35	1 35	1 30	1 23	1 12	0 59	0 25										38
1 27	1 32	1 33	1 31	1 25	1 16	1 4	0 34										39
1 22	1 28	1 31	1 30	1 26	1 19	1 8	0 41										40
1 15	1 23	1 28	1 28	1 26	1 20	1 12	0 47										41
1 7	1 17	1 24	1 26	1 25	1 21	1 14	0 52	0 22									42
0 59	1 11	1 19	1 23	1 24	1 21	1 16	0 57	0 29									43
0 50	1 3	1 13	1 19	1 21	1 21	1 17	1 1	0 36									44
0 30	0 47	1 0	1 9	1 15	1 17	1 16	1 5	0 46	0 20								46
	0 28	0 44	0 56	1 5	1 10	1 12	1 7	0 53	0 31								48
		0 25	0 41	0 53	1 1	1 6	1 7	0 57	0 40	0 18							50
			0 24	0 38	0 50	0 57	1 3	0 58	0 46	0 28							52
				0 22	0 36	0 46	0 57	0 57	0 49	0 35	0 16						54
					0 21	0 34	0 50	0 54	0 50	0 39	0 24						56
						0 20	0 40	0 49	0 49	0 41	0 29	0 15					58
							0 30	0 42	0 46	0 42	0 33	0 21					60
							0 18	0 35	0 41	0 41	0 34	0 25	0 14				62
								0 26	0 36	0 38	0 34	0 27	0 18				64
								0 16	0 30	0 34	0 33	0 28	0 21	0 13			66
									0 22	0 30	0 31	0 28	0 22	0 16			68
									0 15	0 25	0 28	0 26	0 22	0 18	0 13		70
										0 20	0 25	0 25	0 22	0 18	0 14		72
										0 14	0 21	0 22	0 21	0 18	0 15	0 13	74
											0 17	0 20	0 20	0 17	0 15	0 13	76
											0 13	0 18	0 18	0 17	0 15	0 13	78
												0 15	0 16	0 15	0 14	0 13	80
												0 13	0 15	0 15	0 13	0 12	82
													0 14	0 13	0 13		84
													0 13	0 13			86
34°	36°	38°	40°	42°	44°	46°	50°	54°	58°	62°	66°	70°	74°	78°	82°	86°	

TABLE 36.

APPARENT DISTANCE, 14°

Apparent Altitude of the Sun or Star.

☾'s Alt.	6°	7°	8°	9°	10°	11°	12°	14°	16°	18°	20°	22°	24°	26°	28°	30°	32°	☾'s Alt.
	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	
6°	2 6	2 6	2 13	2 24	2 39	2 56	3 14	3 53	4 33	5 13	5 51							6°
7	2 15	2 6	2 6	2 10	2 19	2 30	2 43	3 11	3 41	4 11	4 52							7
8	2 28	2 12	2 6	2 5	2 9	2 15	2 23	2 44	3 6	3 29	3 51	4 11						8
9	2 44	2 22	2 10	2 5	2 5	2 7	2 12	2 26	2 42	2 59	3 15	3 30						9
10	3 2	2 35	2 18	2 9	2 5	2 4	2 6	2 14	2 25	2 38	2 50	3 1	3 10					10
11	3 21	2 48	2 28	2 15	2 8	2 4	2 3	2 7	2 14	2 23	2 32	2 39	2 45					11
12	3 40	3 3	2 38	2 22	2 12	2 6	2 3	2 3	2 7	2 13	2 19	2 24	2 27	2 29				12
13	3 59	3 18	2 50	2 31	2 18	2 10	2 5	2 1	2 3	2 6	2 10	2 13	2 14	2 14				13
14	4 18	3 32	3 1	2 39	2 24	2 14	2 8	2 1	2 0	2 2	2 4	2 5	2 5	2 4	2 1			14
15	4 35	3 46	3 12	2 48	2 31	2 19	2 11	2 2	1 59	1 59	2 0	2 0	1 59	1 57	1 52			15
16	4 53	4 0	3 23	2 56	2 38	2 24	2 15	2 4	1 59	1 58	1 57	1 57	1 55	1 52	1 47	1 40		16
17	5 9	4 12	3 33	3 4	2 43	2 29	2 18	2 6	2 0	1 57	1 56	1 55	1 52	1 49	1 43	1 36		17
18	5 24	4 24	3 42	3 12	2 50	2 33	2 22	2 8	2 1	1 57	1 55	1 53	1 51	1 47	1 41	1 34	1 24	18
19	5 38	4 35	3 51	3 19	2 55	2 37	2 25	2 9	2 1	1 57	1 55	1 53	1 50	1 46	1 40	1 33	1 23	19
20	5 51	4 45	3 58	3 24	2 59	2 41	2 27	2 11	2 2	1 57	1 55	1 52	1 50	1 46	1 40	1 33	1 24	20
21		4 54	4 5	3 30	3 3	2 44	2 30	2 12	2 2	1 57	1 54	1 52	1 49	1 46	1 40	1 33	1 24	21
22			4 11	3 34	3 6	2 46	2 31	2 12	2 2	1 57	1 54	1 52	1 49	1 46	1 41	1 34	1 26	22
23				3 37	3 8	2 47	2 32	2 12	2 1	1 56	1 53	1 51	1 49	1 46	1 42	1 36	1 27	23
24					3 10	2 48	2 32	2 11	2 0	1 55	1 52	1 51	1 49	1 46	1 42	1 37	1 29	24
25						2 47	2 31	2 10	1 58	1 53	1 51	1 50	1 49	1 46	1 43	1 38	1 31	25
26							2 29	2 7	1 56	1 51	1 49	1 48	1 48	1 46	1 43	1 39	1 33	26
27								2 4	1 53	1 48	1 47	1 46	1 46	1 45	1 43	1 39	1 34	27
28								2 1	1 49	1 45	1 44	1 44	1 44	1 44	1 43	1 40	1 35	28
29									1 45	1 41	1 40	1 41	1 42	1 42	1 42	1 40	1 36	29
30									1 40	1 36	1 36	1 37	1 39	1 40	1 40	1 39	1 36	30
31										1 31	1 31	1 33	1 35	1 38	1 39	1 38	1 36	31
32										1 24	1 25	1 28	1 31	1 34	1 36	1 37	1 36	32
33											1 19	1 23	1 27	1 31	1 34	1 35	1 35	33
34											1 13	1 17	1 22	1 26	1 30	1 33	1 33	34
35												1 10	1 16	1 22	1 26	1 30	1 31	35
36												1 3	1 10	1 16	1 22	1 25	1 29	36
37													1 3	1 10	1 17	1 22	1 26	37
38													0 56	1 3	1 12	1 18	1 22	38
39														0 57	1 5	1 13	1 18	39
40														0 50	0 58	1 7	1 14	40
41															0 52	1 1	1 9	41
42															0 45	0 54	1 3	42
43																0 48	0 57	43
44																0 40	0 50	44
46																	0 37	46

TABLE 4a.

Difference for One Minute ☾'s Horizontal Parallax.

Apparent Altitude of the Sun or Star.

☾'s Alt.	6°	10°	16°	20°	30°	40°	50°	62°	74°	86°	☾'s Alt.
	″	″	″	″	″	″	″	″	″	″	
6°	4·0	3·4	1·7	0							6
10	3·8	3·9	3·0	1·7							10
15	2·5	3·4	3·7	3·1							15
20	0	1·9	3·3	3·5	1·6						20
25			2·1	3·0	2·5						25
30			0	1·6	3·0	1·3					30
35					2·5	2·2					35
40					1·3	2·3	1·0				40
50						1·0	1·6	0·3			50
60							0·6	0·9			60
70								0·4	0·3		70
80									0·1		80
86	Add for every min. ☾'s H.P. above 57. Subtract ,, ,, under 57.									0	86
	6°	10°	16°	20°	30°	40°	50°	62°	74°	86°	

TABLE 36.

APPARENT DISTANCE, 14°

Apparent Altitude of the Sun or Star.

34°	36°	38°	40°	42°	44°	46°	50°	54°	58°	62°	66°	70°	74°	78°	82°	86°	☾'s Alt.
′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	
																	6°
																	7
																	8
																	9
																	10
																	11
																	12
																	13
																	14
																	15
																	16
																	17
																	18
																	19
1 13																	20
1 14																	21
1 15	1 3																22
1 18	1 6																23
1 20	1 9	0 56															24
1 22	1 12	0 59															25
1 25	1 15	1 3	0 50														26
1 27	1 18	1 7	0 54														27
1 29	1 20	1 10	0 58	0 45													28
1 30	1 23	1 13	1 2	0 49													29
1 31	1 25	1 16	1 6	0 54	0 40												30
1 32	1 27	1 19	1 9	0 58	0 45												31
1 33	1 28	1 21	1 12	1 2	0 50	0 37											32
1 33	1 29	1 23	1 15	1 6	0 55	0 42											33
1 32	1 29	1 24	1 17	1 9	0 58	0 47											34
1 31	1 29	1 25	1 19	1 11	1 2	0 51											35
1 29	1 28	1 25	1 20	1 13	1 5	0 55	0 31										36
1 27	1 27	1 25	1 21	1 15	1 8	0 58	0 36										37
1 25	1 26	1 24	1 21	1 16	1 10	1 1	0 41										38
1 22	1 23	1 23	1 21	1 17	1 11	1 4	0 45										39
1 18	1 21	1 22	1 20	1 17	1 12	1 6	0 49	0 27									40
1 14	1 18	1 19	1 19	1 17	1 13	1 7	0 52	0 32									41
1 10	1 14	1 17	1 18	1 16	1 13	1 9	0 55	0 36									42
1 5	1 10	1 14	1 15	1 15	1 13	1 9	0 57	0 40									43
0 59	1 6	1 10	1 13	1 13	1 12	1 9	0 59	0 43	0 24								44
0 47	0 56	1 2	1 7	1 9	1 10	1 8	1 1	0 48	0 32								46
0 34	0 44	0 52	0 59	1 3	1 5	1 5	1 2	0 52	0 38	0 21							48
	0 31	0 41	0 49	0 55	0 59	1 1	1 0	0 54	0 42	0 28							50
		0 29	0 39	0 46	0 52	0 56	0 58	0 54	0 45	0 33	0 20						52
			0 27	0 36	0 44	0 49	0 54	0 52	0 46	0 37	0 25						54
				0 25	0 34	0 41	0 49	0 50	0 46	0 39	0 29	0 18					56
					0 24	0 32	0 43	0 46	0 45	0 40	0 31	0 22					58
						0 23	0 36	0 42	0 43	0 39	0 33	0 25	0 17				60
							0 28	0 37	0 40	0 38	0 33	0 27	0 20				62
							0 20	0 31	0 36	0 36	0 33	0 28	0 22	0 16			64
								0 25	0 32	0 33	0 32	0 28	0 23	0 18			66
								0 19	0 27	0 30	0 30	0 27	0 23	0 19	0 15		68
									0 22	0 27	0 28	0 26	0 23	0 19	0 16		70
									0 17	0 23	0 25	0 25	0 22	0 19	0 17	0 15	72
										0 20	0 23	0 23	0 21	0 19	0 17	0 15	74
										0 16	0 20	0 21	0 20	0 18	0 16	0 15	76
											0 18	0 19	0 19	0 18	0 16	0 15	78
											0 16	0 18	0 18	0 17	0 15	0 14	80
												0 16	0 17	0 16	0 15		82
												0 15	0 16	0 15	0 14		84
													0 15	0 15			86
34°	36°	38°	40°	42°	44°	46°	50°	54°	58°	62°	66°	70°	74°	78°	82°	86°	

TABLE 36.

APPARENT DISTANCE, 16°

Apparent Altitude of the Sun or Star.

☾'s Alt.	6°	7°	8°	9°	10°	11°	12°	14°	16°	18°	20°	22°	24°	26°	28°	30°	32°
	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″
6°	1 54	1 54	2 0	2 10	2 24	2 40	2 57	3 34	4 13	4 53	5 30	6 7					
7	2 1	1 54	1 53	1 58	2 6	2 16	2 29	2 56	3 26	3 56	4 26	4 54					
8	2 13	1 59	1 53	1 53	1 56	2 3	2 11	2 31	2 53	3 17	3 41	4 3	4 24				
9	2 28	2 8	1 58	1 53	1 52	1 55	2 0	2 13	2 30	2 49	3 7	3 25	3 41				
10	2 45	2 20	2 5	1 56	1 52	1 52	1 51	2 2	2 14	2 28	2 42	2 56	3 9	3 21			
11	3 2	2 33	2 14	2 2	1 55	1 52	1 51	1 55	2 4	2 14	2 25	2 35	2 45	2 54			
12	3 21	2 47	2 24	2 9	1 59	1 54	1 51	1 51	1 56	2 3	2 12	2 21	2 27	2 33	2 39		
13	3 39	3 1	2 36	2 17	2 5	1 57	1 53	1 50	1 52	1 56	2 0	2 8	2 14	2 18	2 21		
14	3 58	3 16	2 46	2 26	2 11	2 2	1 55	1 49	1 49	1 54	1 56	2 0	2 3	2 6	2 8	2 9	
15	4 16	3 30	2 58	2 35	2 18	2 7	1 59	1 50	1 48	1 49	1 51	1 54	1 56	1 58	1 58	1 58	
16	4 34	3 44	3 9	2 44	2 26	2 12	2 3	1 52	1 48	1 47	1 48	1 49	1 51	1 51	1 51	1 50	1 47
17	4 51	3 58	3 20	2 53	2 33	2 18	2 7	1 54	1 48	1 46	1 46	1 46	1 47	1 47	1 46	1 44	1 41
18	5 7	4 11	3 31	3 2	2 40	2 24	2 12	1 57	1 49	1 46	1 44	1 44	1 44	1 43	1 42	1 40	1 36
19	5 23	4 24	3 41	3 10	2 46	2 29	2 16	1 59	1 50	1 46	1 44	1 43	1 42	1 41	1 39	1 36	1 32
20	5 39	4 36	3 51	3 18	2 53	2 34	2 20	2 2	1 52	1 46	1 44	1 42	1 41	1 39	1 37	1 34	1 30
21	5 53	4 48	4 0	3 25	2 59	2 39	2 24	2 4	1 53	1 47	1 44	1 42	1 40	1 38	1 36	1 33	1 29
22	6 7	4 58	4 9	3 32	3 4	2 43	2 27	2 6	1 54	1 47	1 44	1 41	1 39	1 38	1 35	1 32	1 28
23		5 8	4 17	3 38	3 9	2 47	2 30	2 8	1 55	1 48	1 44	1 41	1 39	1 37	1 35	1 32	1 28
24			4 24	3 44	3 14	2 51	2 33	2 9	1 56	1 48	1 43	1 41	1 39	1 37	1 34	1 31	1 27
25				3 49	3 18	2 54	2 35	2 10	1 56	1 48	1 43	1 40	1 38	1 36	1 34	1 31	1 27
26					3 21	2 56	2 37	2 11	1 56	1 47	1 43	1 40	1 38	1 36	1 34	1 31	1 28
27						2 58	2 38	2 11	1 56	1 47	1 42	1 39	1 37	1 35	1 34	1 31	1 28
28							2 39	2 11	1 57	1 46	1 41	1 38	1 36	1 35	1 33	1 31	1 28
29								2 10	1 54	1 44	1 39	1 36	1 35	1 34	1 32	1 31	1 28
30								2 9	1 52	1 43	1 37	1 35	1 33	1 33	1 32	1 30	1 28
31									1 50	1 38	1 35	1 33	1 32	1 31	1 30	1 29	1 28
32									1 47	1 38	1 33	1 30	1 30	1 29	1 29	1 29	1 27
33										1 35	1 30	1 28	1 27	1 27	1 28	1 27	1 26
34										1 31	1 26	1 24	1 24	1 25	1 25	1 26	1 25
35											1 24	1 21	1 21	1 22	1 23	1 24	1 24
36											1 19	1 17	1 18	1 19	1 21	1 22	1 22
37												1 13	1 14	1 16	1 18	1 19	1 20
38												1 9	1 10	1 12	1 15	1 17	1 18
39													1 6	1 8	1 11	1 14	1 16
40													1 1	1 4	1 7	1 10	1 13
41														0 59	1 3	1 7	1 10
42														0 54	0 58	1 3	1 6
43															0 54	0 58	1 3
44															0 49	0 54	0 59
46																0 44	0 50
48																	0 41

TABLE 4*a*.

Differences for One Minute ☾'s Horizontal Parallax.

Apparent Altitude of the Sun or Star.

☾'s Alt.	6°	10°	16°	20°	30°	40°	50°	62°	74°	86°	☾'s Alt.
	″	″	″	″	″	″	″	″	″	″	
6°	3·4	3·0	1·9	0·7							6°
10	3·4	3·4	2·7	1·9							10
15	2·4	3·1	3·2	2·8	0·3						15
20	0·9	2·1	3·0	3·0	1·7						20
25		0·4	2·1	2·6	2·4	0·3					25
30			0·7	1·8	2·6	1·4					30
35				0·3	2·2	1·9	0·2				35
40					1·4	2·0	1·0				40
50						1·0	1·4	0·4			50
60							0·7	0·7	0·1		60
70								0·4	0·3	0	70
80									0·1		80
86											86
	6°	10°	16°	20°	30°	40°	50°	62°	74°	86°	

Add for every min. ☾'s H P. above 57.
Subtract ,, ,, under 57.

TABLE 36.

APPARENT DISTANCE, 16°

Apparent Altitude of the Sun or Star.

’s lt.	34°	36°	38°	40°	42°	44°	46°	50°	54°	58°	62°	66°	70°	74°	78°	82°	86°	☾’s Alt.
	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	
6°																		6°
7																		7
8																		8
9																		9
10																		10
11																		11
12																		12
13																		13
14																		14
15																		15
16																		16
17																		17
18	1 31																	18
19	1 27																	19
20	1 25	1 19																20
21	1 23	1 17																21
22	1 22	1 16	1 9															22
23	1 22	1 16	1 9															23
24	1 22	1 16	1 9	1 1														24
25	1 23	1 17	1 10	1 2														25
26	1 23	1 17	1 11	1 3	0 54													26
27	1 24	1 18	1 12	1 4	0 56													27
28	1 24	1 19	1 13	1 6	0 58	0 49												28
29	1 24	1 20	1 14	1 8	1 0	0 51												29
30	1 25	1 21	1 15	1 9	1 2	0 53	0 44											30
31	1 25	1 21	1 16	1 10	1 4	0 56	0 47											31
32	1 25	1 21	1 17	1 12	1 5	0 58	0 50											32
33	1 24	1 22	1 18	1 13	1 7	1 0	0 52											33
34	1 24	1 21	1 18	1 14	1 8	1 2	0 54	0 37										34
35	1 23	1 21	1 18	1 14	1 9	1 3	0 56	0 40										35
36	1 22	1 21	1 18	1 15	1 10	1 5	0 58	0 43										36
37	1 20	1 20	1 18	1 15	1 11	1 6	1 0	0 46										37
38	1 19	1 18	1 17	1 15	1 11	1 7	1 1	0 48	0 32									38
39	1 17	1 17	1 16	1 14	1 11	1 7	1 2	0 50	0 35									39
40	1 15	1 15	1 15	1 14	1 11	1 8	1 3	0 52	0 38									40
41	1 12	1 13	1 13	1 13	1 11	1 8	1 4	0 54	0 40									41
42	1 9	1 11	1 12	1 11	1 10	1 8	1 4	0 55	0 43	0 28								42
43	1 6	1 8	1 10	1 10	1 9	1 7	1 4	0 56	0 44	0 31								43
44	1 3	1 6	1 7	1 8	1 8	1 7	1 4	0 57	0 46	0 34								44
46	0 55	0 59	1 2	1 4	1 5	1 4	1 3	0 58	0 49	0 38	0 25							46
48	0 47	0 52	0 56	0 59	1 0	1 1	1 1	0 57	0 50	0 41	0 30							48
50	0 37	0 43	0 48	0 53	0 55	0 57	0 58	0 56	0 51	0 43	0 33	0 23						50
52		0 35	0 41	0 46	0 49	0 52	0 54	0 54	0 51	0 44	0 36	0 27						52
54			0 32	0 38	0 43	0 47	0 49	0 51	0 49	0 45	0 38	0 30	0 21					54
56				0 30	0 36	0 40	0 44	0 47	0 47	0 44	0 38	0 32	0 24					56
58					0 28	0 34	0 38	0 43	0 45	0 43	0 38	0 33	0 26	0 20				58
60						0 27	0 32	0 39	0 41	0 41	0 38	0 33	0 27	0 22				60
62							0 25	0 34	0 38	0 39	0 37	0 33	0 28	0 23	0 19			62
64								0 28	0 34	0 36	0 35	0 32	0 28	0 24	0 20			64
66								0 23	0 30	0 33	0 33	0 31	0 28	0 24	0 21	0 18		66
68									0 25	0 30	0 31	0 30	0 27	0 24	0 21	0 18	0 17	68
70									0 21	0 26	0 28	0 28	0 26	0 24	0 21	0 19	0 17	70
72										0 23	0 26	0 26	0 25	0 23	0 21	0 19	0 17	72
74										0 20	0 23	0 24	0 24	0 22	0 20	0 18	0 17	74
76											0 21	0 22	0 22	0 21	0 19	0 18		76
78											0 19	0 21	0 21	0 20	0 19	0 17		78
80												0 19	0 20	0 19	0 18	0 17		80
82												0 18	0 19	0 18	0 17			82
84													0 18	0 18				84
86													0 17	0 17				86
	34°	36°	38°	40°	42°	44°	46°	50°	54°	58°	62°	66°	70°	74°	78°	82°	86°	

TABLE 36.

APPARENT DISTANCE, 18°

☾'s Alt.	6°	7°	8°	9°	10°	11°	12°	14°	16°	18°	20°	22°	24°	26°	28°	30°	32°
	' "	' "	' "	' "	' "	' "	' "	' "	' "	' "	' "	' "	' "	' "	' "	' "	' "
6°	1 44	1 44	1 50	2 0	2 13	2 27	2 43	3 18	3 54	4 31	5 8	5 45	6 20				
7	1 51	1 44	1 44	1 49	1 56	2 6	2 17	2 43	3 11	3 40	4 10	4 39	5 7				
8	2 2	1 49	1 44	1 45	1 47	1 53	2 1	2 20	2 42	3 5	3 28	3 51	4 14	4 35			
9	2 16	1 58	1 48	1 44	1 45	1 46	1 50	2 4	2 20	2 38	2 57	3 16	3 34	3 51			
10	2 31	2 8	1 54	1 47	1 43	1 43	1 45	1 53	2 5	2 19	2 34	2 49	3 4	3 18	3 31		
11	2 48	2 20	2 3	1 52	1 45	1 43	1 43	1 46	1 55	2 6	2 17	2 29	2 41	2 52	3 2		
12	3 5	2 34	2 13	1 59	1 50	1 44	1 42	1 42	1 48	1 55	2 4	2 14	2 23	2 32	2 40	2 47	
13	3 23	2 47	2 23	2 6	1 55	1 48	1 43	1 41	1 43	1 48	1 55	2 3	2 10	2 17	2 23	2 28	
14	3 40	3 1	2 34	2 15	2 2	1 52	1 46	1 41	1 41	1 44	1 48	1 54	2 0	2 5	2 9	2 13	2 17
15	3 58	3 15	2 45	2 24	2 8	1 57	1 50	1 42	1 39	1 40	1 44	1 47	1 52	1 56	1 59	2 2	2 4
16	4 15	3 28	2 57	2 33	2 16	2 3	1 54	1 43	1 39	1 39	1 40	1 43	1 46	1 49	1 51	1 53	1 54
17	4 33	3 43	3 8	2 42	2 23	2 9	1 58	1 46	1 40	1 38	1 38	1 39	1 41	1 43	1 45	1 46	1 46
18	4 49	3 57	3 19	2 51	2 30	2 15	2 3	1 48	1 41	1 37	1 36	1 37	1 38	1 39	1 40	1 40	1 40
19	5 6	4 10	3 30	3 0	2 38	2 21	2 8	1 51	1 42	1 38	1 36	1 36	1 36	1 36	1 36	1 36	1 35
20	5 22	4 23	3 41	3 9	2 45	2 26	2 13	1 54	1 44	1 38	1 35	1 34	1 34	1 34	1 34	1 33	1 32
21	5 37	4 36	3 51	3 17	2 52	2 32	2 17	1 57	1 46	1 39	1 35	1 34	1 33	1 32	1 32	1 31	1 29
22	5 52	4 47	4 1	3 25	2 58	2 38	2 22	2 0	1 47	1 40	1 36	1 33	1 32	1 31	1 30	1 29	1 27
23	6 6	4 59	4 10	3 33	3 4	2 43	2 26	2 3	1 49	1 41	1 36	1 33	1 31	1 30	1 29	1 28	1 26
24	6 20	5 10	4 19	3 40	3 11	2 48	2 30	2 6	1 51	1 42	1 36	1 33	1 31	1 30	1 28	1 27	1 25
25		5 20	4 27	3 47	3 16	2 52	2 34	2 8	1 52	1 42	1 37	1 33	1 31	1 29	1 28	1 26	1 24
26			4 35	3 54	3 21	2 57	2 37	2 10	1 53	1 43	1 37	1 33	1 30	1 29	1 27	1 25	1 23
27				4 0	3 26	3 0	2 40	2 12	1 54	1 44	1 37	1 33	1 30	1 28	1 27	1 25	1 23
28					3 31	3 4	2 43	2 14	1 55	1 44	1 37	1 32	1 30	1 28	1 26	1 24	1 22
29						3 7	2 45	2 15	1 56	1 44	1 37	1 32	1 29	1 27	1 26	1 24	1 22
30							2 47	2 16	1 56	1 44	1 36	1 31	1 29	1 26	1 25	1 23	1 22
31								2 16	1 56	1 43	1 36	1 31	1 28	1 26	1 24	1 23	1 21
32								2 17	1 56	1 43	1 35	1 30	1 27	1 25	1 23	1 22	1 21
33									1 55	1 43	1 33	1 28	1 26	1 24	1 23	1 21	1 20
34									1 54	1 41	1 32	1 27	1 24	1 23	1 21	1 20	1 19
35										1 39	1 31	1 26	1 23	1 21	1 20	1 19	1 18
36										1 37	1 29	1 24	1 21	1 19	1 18	1 17	1 17
37											1 27	1 21	1 19	1 18	1 17	1 16	1 16
38											1 24	1 19	1 17	1 15	1 15	1 15	1 15
39												1 17	1 14	1 13	1 13	1 13	1 13
40												1 14	1 12	1 11	1 10	1 11	1 11
41													1 9	1 8	1 8	1 9	1 9
42													1 6	1 5	1 5	1 6	1 7
43														1 2	1 2	1 4	1 5
44														0 59	0 59	1 1	1 2
46															0 53	0 55	0 57
48																0 48	0 51
																	0 44

TABLE 4*a*.

Differences for One Minute ☾'s Horizontal Parallax.

☾'s Alt.	6°	10°	16°	20°	30°	40°	50°	62°	74°	86°	☾'s Alt.
	"	"	"	"	"	"	"	"	"	"	
6°	3·0	2·7	1·9	1·0							6°
10	3·0	3·0	2·5	1·9							10
15	2·4	2·8	2·8	2·5	0·8						15
20	1·3	2·1	2·6	2·7	1·7						20
25		0·9	2·0	2·4	2·2	0·6					25
30			1·0	1·8	2·3	1·4					30
35				0·7	2·0	1·7	0·5				35
40					1·4	1·8	1·0				40
50						1·0	1·2	0·5			50
60							0·6	0·6	0·2		60
70								0·3	0·2	0	70
80								0	0·1		80
86											86

Add for every min. ☾'s H.P. above 57.
Subtract „ „ under 57.

TABLE 36.

APPARENT DISTANCE, 18°

Apparent Altitude of the Sun or Star.

’s lt.	34°	36°	38°	40°	42°	44°	46°	50°	54°	58°	62°	66°	70°	74°	78°	82°	86°	☾’s Alt.
	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	
6°																		6°
7																		7
8																		8
9																		9
10																		10
11																		11
12																		12
13																		13
14																		14
15																		15
16	1 54																	16
17	1 46																	17
18	1 39	1 37																18
19	1 34	1 32																19
20	1 30	1 27	1 24															20
21	1 27	1 24	1 21															21
22	1 25	1 22	1 18	1 14														22
23	1 23	1 20	1 17	1 12														23
24	1 22	1 19	1 15	1 11	1 6													24
25	1 21	1 18	1 14	1 10	1 5													25
26	1 21	1 18	1 14	1 9	1 4	0 59												26
27	1 20	1 17	1 14	1 9	1 4	0 59												27
28	1 20	1 17	1 13	1 9	1 4	0 59	0 53											28
29	1 20	1 17	1 13	1 10	1 5	0 59	0 54											29
30	1 19	1 17	1 14	1 10	1 5	1 0	0 54											30
31	1 19	1 17	1 14	1 10	1 6	1 1	0 55											31
32	1 19	1 17	1 14	1 10	1 6	1 1	0 56	0 44										32
33	1 18	1 16	1 14	1 10	1 7	1 2	0 57	0 45										33
34	1 18	1 16	1 13	1 10	1 7	1 3	0 58	0 47										34
35	1 17	1 16	1 13	1 10	1 7	1 3	0 59	0 48										35
36	1 16	1 15	1 13	1 10	1 7	1 4	0 59	0 49	0 38									36
37	1 15	1 14	1 12	1 10	1 7	1 4	1 0	0 51	0 39									37
38	1 14	1 13	1 12	1 10	1 7	1 4	1 1	0 51	0 41									38
39	1 13	1 12	1 11	1 9	1 7	1 4	1 1	0 52	0 42									39
40	1 12	1 11	1 10	1 9	1 7	1 4	1 1	0 53	0 44	0 33								40
41	1 10	1 10	1 9	1 8	1 6	1 4	1 1	0 54	0 45	0 35								41
42	1 8	1 8	1 8	1 7	1 6	1 4	1 1	0 55	0 46	0 36								42
43	1 6	1 6	1 6	1 6	1 5	1 3	1 1	0 55	0 47	0 38								43
44	1 3	1 4	1 5	1 5	1 4	1 3	1 1	0 55	0 48	0 39	0 29							44
46	0 59	1 0	1 1	1 2	1 1	1 1	0 59	0 55	0 49	0 41	0 32							46
48	0 53	0 55	0 57	0 58	0 59	0 58	0 58	0 54	0 49	0 42	0 35	0 26						48
50	0 47	0 50	0 52	0 54	0 55	0 56	0 55	0 53	0 49	0 43	0 33	0 29						50
52	0 41	0 44	0 47	0 49	0 51	0 52	0 52	0 51	0 48	0 44	0 38	0 31	0 24					52
54		0 38	0 41	0 44	0 46	0 48	0 49	0 49	0 47	0 43	0 38	0 32	0 26					54
56			0 35	0 39	0 41	0 44	0 45	0 46	0 46	0 43	0 38	0 33	0 28	0 23				56
58				0 33	0 36	0 39	0 41	0 44	0 43	0 41	0 38	0 33	0 29	0 24				58
60					0 31	0 34	0 37	0 40	0 41	0 40	0 37	0 33	0 29	0 25	0 21			60
62						0 29	0 32	0 37	0 38	0 38	0 36	0 33	0 29	0 26	0 22			62
64							0 28	0 33	0 35	0 36	0 34	0 32	0 29	0 26	0 23	0 20		64
66								0 29	0 32	0 34	0 33	0 31	0 28	0 25	0 23	0 20		66
68								0 25	0 29	0 31	0 31	0 30	0 28	0 25	0 23	0 21	0 19	68
70									0 26	0 29	0 29	0 28	0 27	0 24	0 22	0 21	0 19	70
72									0 23	0 26	0 27	0 27	0 26	0 24	0 22	0 20	0 19	72
74										0 24	0 26	0 26	0 24	0 23	0 21	0 20	0 19	74
76										0 22	0 24	0 24	0 24	0 22	0 21	0 19		76
78											0 22	0 23	0 22	0 21	0 20	0 19		78
80											0 21	0 22	0 21	0 21	0 19			80
82												0 20	0 21	0 20	0 19			82
84												0 20	0 20	0 19				84
86													0 19	0 19				86
	34°	36°	38°	40°	42°	44°	46°	50°	54°	58°	62°	66°	70°	74°	78°	82°	86°	

TABLE 36.

APPARENT DISTANCE, 22°

Apparent Altitude of the Sun or Star.

☽'s Alt.	6°	7°	8°	9°	10°	11°	12°	14°	16°	18°	20°	22°	24°	26°	28°	30°	32°	☾'s Alt.
	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	
6°	1 22	1 24	1 29	1 37	1 47	2 0	2 15	2 46	3 19	3 52	4 27	5 1	5 35	6 12	6 40			6°
7	1 29	1 23	1 23	1 26	1 34	1 43	1 54	2 15	2 41	3 8	3 38	4 5	4 31	5 2	5 24			7
8	1 37	1 27	1 22	1 20	1 24	1 30	1 37	1 54	2 14	2 35	2 58	3 21	3 44	4 10	4 26	4 49		8
9	1 49	1 35	1 26	1 20	1 20	1 23	1 25	1 35	1 54	2 12	2 32	2 50	3 9	3 32	3 44	4 2		9
10	2 3	1 44	1 29	1 22	1 19	1 20	1 21	1 29	1 40	1 53	2 9	2 25	2 41	3 1	3 10	3 24	3 46	10
11	2 17	1 56	1 44	1 32	1 23	1 21	1 20	1 25	1 31	1 42	1 54	2 7	2 21	2 38	2 45	2 57	3 11	11
12	2 32	2 5	1 47	1 40	1 25	1 22	1 19	1 20	1 25	1 31	1 42	1 53	2 5	2 20	2 25	2 35	2 45	12
13	2 48	2 17	1 59	1 44	1 30	1 28	1 22	1 19	1 22	1 26	1 34	1 42	1 52	2 6	2 10	2 18	2 27	13
14	3 5	2 30	2 6	1 48	1 36	1 29	1 23	1 18	1 18	1 21	1 27	1 38	1 42	1 54	1 56	2 3	2 11	14
15	3 21	2 44	2 17	2 2	1 42	1 34	1 25	1 20	1 17	1 19	1 22	1 27	1 34	1 44	1 45	1 53	1 58	15
16	3 42	2 57	2 28	2 5	1 50	1 40	1 30	1 21	1 17	1 17	1 19	1 23	1 27	1 37	1 38	1 42	1 48	16
17	4 5	3 10	2 43	2 23	2 3	1 44	1 35	1 22	1 17	1 17	1 17	1 19	1 22	1 31	1 30	1 35	1 39	17
18	4 20	3 22	2 58	2 21	2 5	1 49	1 38	1 25	1 18	1 15	1 15	1 16	1 19	1 25	1 24	1 27	1 30	18
19	4 38	3 42	3 5	2 37	2 10	1 56	1 42	1 29	1 19	1 16	1 16	1 15	1 16	1 19	1 22	1 26	1 27	19
20	4 44	3 51	3 10	2 39	2 18	2 2	1 48	1 34	1 23	1 17	1 15	1 13	1 12	1 15	1 19	1 18	1 19	20
21	4 57	4 3	3 16	2 51	2 21	2 8	1 54	1 36	1 25	1 17	1 15	1 12	1 11	1 12	1 12	1 15	1 17	21
22	5 15	4 16	3 32	2 58	2 35	2 16	1 59	1 39	1 27	1 19	1 15	1 12	1 11	1 12	1 12	1 13	1 13	22
23	5 30	4 31	3 44	3 6	2 47	2 23	2 5	1 44	1 28	1 19	1 14	1 12	1 11	1 11	1 11	1 12	1 12	23
24	5 47	4 43	3 56	3 18	2 51	2 31	2 11	1 49	1 31	1 22	1 15	1 12	1 11	1 11	1 11	1 11	1 12	24
25	6 1	4 54	4 6	3 27	2 56	2 34	2 15	1 52	1 33	1 23	1 16	1 13	1 11	1 10	1 10	1 10	1 10	25
26	6 15	5 6	4 14	3 34	3 0	2 42	2 21	1 56	1 37	1 25	1 17	1 14	1 11	1 10	1 10	1 9	1 9	26
27	6 26	5 19	4 22	3 51	3 7	2 46	2 26	1 58	1 39	1 26	1 20	1 14	1 11	1 10	1 9	1 8	1 8	27
28	6 35	5 30	4 34	3 53	3 17	2 51	2 31	2 2	1 42	1 27	1 21	1 15	1 12	1 9	1 9	1 8	1 7	28
29		5 49	4 42	3 56	3 25	2 56	2 36	2 6	1 44	1 29	1 22	1 15	1 12	1 9	1 9	1 7	1 6	29
30			4 52	3 57	3 31	3 1	2 41	2 10	1 47	1 31	1 23	1 16	1 12	1 8	1 8	1 7	1 5	30
31				4 6	3 40	3 7	2 46	2 15	1 52	1 34	1 24	1 17	1 12	1 8	1 8	1 6	1 4	31
32					3 44	3 14	2 51	2 17	1 53	1 36	1 25	1 17	1 12	1 8	1 7	1 5	1 4	32
33						3 19	2 55	2 20	1 54	1 37	1 26	1 18	1 13	1 8	1 7	1 5	1 3	33
34							2 59	2 23	1 56	1 38	1 26	1 18	1 13	1 8	1 7	1 4	1 3	34
35								2 26	1 57	1 39	1 27	1 19	1 14	1 9	1 6	1 4	1 3	35
36								2 28	1 59	1 40	1 28	1 20	1 14	1 9	1 6	1 4	1 2	36
37									2 2	1 42	1 29	1 20	1 14	1 9	1 6	1 3	1 2	37
38									2 5	1 43	1 30	1 20	1 14	1 9	1 6	1 3	1 2	38
39										1 44	1 31	1 20	1 15	1 9	1 5	1 2	1 1	39
40										1 45	1 32	1 21	1 15	1 9	1 5	1 2	1 1	40
41											1 33	1 22	1 16	1 10	1 5	1 2	1 1	41
42											1 34	1 23	1 16	1 10	1 5	1 1	1 0	42
43												1 23	1 16	1 10	1 4	1 1	1 0	43
44												1 24	1 16	1 10	1 4	1 1	1 0	44
46													1 16	1 10	1 4	1 0	0 59	46
48														1 10	1 3	1 0	0 59	48
50															1 3	1 0	0 59	50
52																1 0	0 59	52
54																	0 59	54
56																		56
58																		58
60																		60
62																		62
64																		64
66																		66
68																		68
70																		70
72																		72
74																		74
76																		76
78																		78
80																		80
82																		82
84																		84

TABLE 36.

APPARENT DISTANCE, 22°

Apparent Altitude of the Sun or Star.

's t.	34°	36°	38°	40°	42°	44°	46°	50°	54°	58°	62°	66°	70°	74°	78°	82°	86°	☾'s Alt.
	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	
6°																		6°
7																		7
8																		8
9																		9
0																		10
1																		11
2	2 58																	12
3	2 36																	13
4	2 18	2 25																14
5	2 6	2 12																15
16	1 54	1 58	2 1															16
17	1 44	1 48	1 51															17
18	1 34	1 38	1 40	1 45														18
19	1 29	1 32	1 33	1 36														19
20	1 22	1 24	1 26	1 27	1 30													20
21	1 19	1 20	1 21	1 24	1 25													21
22	1 15	1 16	1 16	1 17	1 18	1 20												22
23	1 12	1 13	1 14	1 15	1 15	1 16												23
24	1 12	1 12	1 12	1 12	1 12	1 12	1 11											24
25	1 10	1 10	1 9	1 9	1 9	1 8	1 8											25
26	1 9	1 9	1 9	1 9	1 8	1 8	1 7											26
27	1 8	1 8	1 8	1 8	1 7	1 7	1 6											27
28	1 7	1 7	1 7	1 7	1 6	1 6	1 5	1 4										28
29	1 6	1 6	1 6	1 5	1 5	1 4	1 4	1 4										29
30	1 4	1 4	1 4	1 4	1 4	1 3	1 3	1 3										30
31	1 4	1 3	1 3	1 3	1 3	1 2	1 2	1 2										31
32	1 3	1 2	1 2	1 2	1 1	1 1	1 1	1 1	0 59									32
33	1 2	1 1	1 1	1 1	1 0	1 0	1 0	1 0	0 58									33
34	1 2	1 1	1 1	1 1	1 0	0 59	0 59	0 59	0 57									34
35	1 2	1 1	1 0	0 59	0 58	0 57	0 56	0 55	0 54									35
36	1 1	1 0	0 58	0 57	0 56	0 55	0 54	0 52	0 47	0 43								36
37	1 1	0 59	0 57	0 57	0 56	0 55	0 53	0 50	0 45	0 42								37
38	1 1	0 59	0 57	0 57	0 56	0 55	0 53	0 49	0 45	0 42								38
39	0 59	0 58	0 57	0 57	0 56	0 54	0 51	0 48	0 44	0 42								39
40	0 59	0 58	0 56	0 57	0 56	0 52	0 50	0 47	0 44	0 42	0 37							40
41	0 59	0 58	0 56	0 56	0 55	0 51	0 50	0 46	0 44	0 42	0 37							41
42	0 59	0 57	0 55	0 55	0 55	0 51	0 49	0 45	0 43	0 40	0 37							42
43	0 58	0 57	0 55	0 54	0 54	0 50	0 49	0 44	0 43	0 39	0 36							43
44	0 57	0 56	0 54	0 53	0 53	0 50	0 48	0 44	0 42	0 39	0 36	0 33						44
46	0 56	0 55	0 53	0 52	0 52	0 50	0 47	0 44	0 42	0 39	0 36	0 33						46
48	0 55	0 54	0 51	0 50	0 50	0 49	0 46	0 43	0 41	0 38	0 36	0 33	0 29					48
50	0 55	0 52	0 49	0 49	0 48	0 47	0 46	0 42	0 41	0 38	0 36	0 33	0 29					50
52	0 54	0 50	0 48	0 48	0 47	0 46	0 45	0 41	0 40	0 37	0 36	0 33	0 29	0 27				52
54	0 50	0 48	0 46	0 45	0 45	0 44	0 43	0 41	0 40	0 37	0 36	0 33	0 31	0 27				54
56	0 46	0 45	0 44	0 43	0 42	0 42	0 41	0 40	0 39	0 36	0 36	0 33	0 30	0 27	0 27			56
58		0 44	0 43	0 42	0 40	0 39	0 39	0 39	0 39	0 36	0 36	0 33	0 30	0 27	0 27			58
60			0 42	0 41	0 39	0 39	0 39	0 39	0 38	0 36	0 36	0 33	0 30	0 27	0 27	0 25		60
62				0 39	0 38	0 37	0 37	0 38	0 38	0 36	0 36	0 33	0 30	0 26	0 26	0 25		62
64					0 37	0 36	0 36	0 36	0 36	0 35	0 35	0 32	0 30	0 26	0 26	0 24	0 23	64
66						0 35	0 35	0 34	0 34	0 34	0 34	0 31	0 30	0 26	0 25	0 24	0 23	66
68							0 34	0 33	0 33	0 33	0 32	0 30	0 28	0 26	0 24	0 23	0 22	68
70								0 32	0 31	0 31	0 30	0 30	0 28	0 26	0 24	0 23	0 21	70
72								0 32	0 31	0 31	0 30	0 30	0 28	0 26	0 24	0 23	0 21	72
74									0 30	0 30	0 30	0 28	0 28	0 25	0 24	0 23		74
76									0 30	0 29	0 29	0 27	0 27	0 24	0 23	0 22		76
78										0 26	0 26	0 24	0 24	0 22	0 22			78
80										0 22	0 22	0 22	0 22	0 19	0 19			80
82											0 22	0 21	0 21	0 19				82
84											0 22	0 21	0 20	0 19				84
86												0 21	0 20					86
	34°	36°	38°	40°	42°	44°	46°	50°	54°	58°	62°	66°	70°	74°	78°	82°	86°	

TABLE 36.

APPARENT DISTANCE, 26°

Apparent Altitude of the Sun or Star.

D's Alt.	6°	7°	8°	9°	10°	11°	12°	14°	16°	18°	20°	22°	24°	26°	28°	30°	32°	D's Alt.
	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	
6°	1 17	1 18	1 24	1 30	1 40	1 50	2 2	2 30	2 59	3 30	4 1	4 30	4 59	5 28	5 54	6 29	6 57	
7	1 25	1 19	1 18	1 23	1 31	1 39	1 48	2 9	2 33	2 58	3 24	3 50	4 15	4 40	5 5	5 27	5 43	
8	1 31	1 19	1 17	1 19	1 22	1 28	1 39	1 45	2 3	2 22	2 42	3 3	3 24	3 44	4 5	4 26	4 44	
9	1 41	1 26	1 18	1 16	1 19	1 21	1 25	1 36	1 51	2 6	2 22	2 39	2 58	3 26	3 34	3 53	4 8	
10	1 50	1 33	1 23	1 17	1 15	1 15	1 15	1 23	1 34	1 46	2 0	2 15	2 39	2 43	2 58	3 13	3 26	
11	2 1	1 43	1 29	1 20	1 16	1 15	1 16	1 21	1 29	1 39	1 51	2 3	2 16	2 28	2 40	2 54	3 6	11
12	2 16	1 53	1 34	1 23	1 20	1 16	1 15	1 15	1 20	1 27	1 36	1 56	1 58	2 6	2 27	2 27	2 36	12
13	2 33	2 3	1 44	1 31	1 25	1 19	1 17	1 15	1 18	1 23	1 29	1 37	1 47	1 55	2 5	2 16	2 24	13
14	2 47	2 14	1 51	1 38	1 28	1 22	1 17	1 12	1 13	1 16	1 22	1 28	1 34	1 41	1 51	2 0	2 6	14
15	3 0	2 25	2 0	1 45	1 35	1 27	1 20	1 14	1 13	1 15	1 19	1 23	1 28	1 35	1 43	1 50	1 56	15
16	3 16	2 39	2 15	1 56	1 42	1 31	1 24	1 15	1 13	1 13	1 15	1 18	1 23	1 27	1 32	1 39	1 44	16
17	3 37	2 51	2 22	2 2	1 49	1 38	1 29	1 18	1 13	1 12	1 13	1 16	1 19	1 22	1 27	1 33	1 37	17
18	3 46	3 3	2 24	2 11	1 54	1 42	1 33	1 21	1 13	1 11	1 12	1 12	1 13	1 16	1 21	1 25	1 28	18
19	4 2	3 15	2 41	2 19	2 2	1 49	1 37	1 24	1 17	1 14	1 12	1 11	1 12	1 13	1 16	1 21	1 23	19
20	4 15	3 27	2 55	2 29	2 9	1 56	1 42	1 28	1 18	1 14	1 10	1 9	1 9	1 10	1 13	1 16	1 18	20
21	4 30	3 38	3 1	2 37	2 19	2 2	1 49	1 30	1 20	1 15	1 10	1 8	1 8	1 9	1 9	1 13	1 15	21
22	4 43	3 50	3 13	2 45	2 23	2 8	1 52	1 34	1 21	1 15	1 10	1 7	1 8	1 8	1 8	1 10	1 12	22
23	4 56	4 2	3 22	2 53	2 33	2 14	1 59	1 37	1 24	1 16	1 11	1 7	1 7	1 7	1 8	1 9	1 10	23
24	5 17	4 15	3 33	3 2	2 41	2 20	2 5	1 42	1 27	1 17	1 12	1 8	1 7	1 7	1 7	1 9	1 9	24
25	5 24	4 26	3 42	3 10	2 48	2 27	2 10	1 46	1 30	1 18	1 12	1 9	1 7	1 6	1 6	1 8	1 8	25
26	5 38	4 37	3 53	3 18	2 51	2 33	2 14	1 50	1 32	1 21	1 13	1 9	1 6	1 6	1 6	1 8	1 7	26
27	5 51	4 48	4 2	3 25	3 1	2 39	2 20	1 52	1 34	1 23	1 15	1 10	1 6	1 6	1 5	1 7	1 6	27
28	6 5	4 59	4 12	3 33	3 8	2 45	2 26	1 57	1 38	1 25	1 17	1 11	1 7	1 6	1 5	1 6	1 5	28
29	6 24	5 5	4 21	3 40	3 14	2 50	2 30	2 1	1 41	1 27	1 18	1 12	1 8	1 6	1 4	1 5	1 4	29
30	6 33	5 21	4 32	3 49	3 19	2 56	2 34	2 6	1 44	1 30	1 20	1 13	1 9	1 5	1 3	1 4	1 3	30
31	6 45	5 40	4 40	3 56	3 28	3 2	2 40	2 10	1 46	1 31	1 21	1 14	1 9	1 5	1 3	1 3	1 2	31
32	6 57	5 51	4 49	4 4	3 35	3 9	2 46	2 13	1 50	1 33	1 24	1 16	1 10	1 5	1 3	1 2	1 1	32
33		5 59	4 57	4 12	3 41	3 13	2 50	2 15	1 52	1 35	1 25	1 16	1 10	1 6	1 2	1 1	1 0	33
34			5 6	4 20	3 47	3 18	2 54	2 19	1 55	1 37	1 26	1 17	1 11	1 6	1 2	1 1	1 0	34
35				4 27	3 52	3 22	2 59	2 24	1 59	1 40	1 27	1 18	1 11	1 6	1 2	1 1	1 0	35
36					3 58	3 28	3 3	2 29	2 3	1 43	1 29	1 19	1 12	1 6	1 2	1 1	1 0	36
37						3 31	3 9	2 35	2 6	1 45	1 31	1 20	1 12	1 6	1 1	1 1	1 0	37
38							3 10	2 35	2 6	1 48	1 33	1 21	1 13	1 7	1 1	1 1	1 0	38
39								2 35	2 9	1 51	1 35	1 23	1 13	1 8	1 1	1 1	1 0	39
40								2 37	2 13	1 53	1 38	1 24	1 14	1 9	1 1	1 1	1 0	40
41									2 15	1 53	1 39	1 26	1 15	1 10	1 2	1 1	1 0	41
42									2 15	1 53	1 40	1 27	1 16	1 10	1 3	1 1	1 0	42
43										1 54	1 40	1 28	1 17	1 11	1 4	1 1	0 59	43
44										1 55	1 40	1 29	1 18	1 11	1 5	1 1	0 59	44
46											1 41	1 30	1 19	1 11	1 5	1 1	0 58	46
48												1 30	1 20	1 12	1 6	1 1	0 58	48
50													1 21	1 12	1 6	1 1	0 58	50
52														1 13	1 6	1 1	0 57	52
54															1 6	1 1	0 56	54
56																1 1	0 56	56
58																	0 56	58
60																		60
62																		62
64																		64
66																		66
68																		68
70																		70
72																		72
74																		74
76																		76
78																		78
80																		80
82																		82
84																		84
86																		86
	6°	7°	8°	9°	10°	11°	12°	14°	16°	18°	20°	22°	24°	26°	28°	30°	32°	

TABLE 36.

APPARENT DISTANCE, 26°

Apparent Altitude of the Sun or Star.

s lt.	34°	36°	38°	40°	42°	44°	46°	50°	54°	58°	62°	66°	70°	74°	78°	82°	86°	☾'s Alt.
	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	
																		6°
																		7
8	5 5																	8
9	4 21																	9
0	3 42	3 56																10
1	3 17	3 26																11
2	2 49	2 58	3 9															12
3	2 34	2 43	2 48															13
4	2 15	2 22	2 33	2 43														14
5	2 3	2 10	2 16	2 23														15
16	1 51	1 57	2 1	2 5	2 13													16
17	1 43	1 48	1 52	1 58	1 59													17
18	1 33	1 36	1 40	1 45	1 49	1 55												18
19	1 28	1 31	1 34	1 38	1 41	1 45												19
20	1 22	1 25	1 28	1 31	1 32	1 35	1 35											20
21	1 18	1 20	1 22	1 25	1 26	1 29	1 30											21
22	1 14	1 16	1 17	1 20	1 21	1 23	1 25											22
23	1 12	1 13	1 14	1 16	1 17	1 18	1 18											23
24	1 10	1 11	1 12	1 13	1 13	1 14	1 15	1 19										24
25	1 8	1 8	1 9	1 10	1 10	1 11	1 12	1 14										25
26	1 6	1 6	1 7	1 7	1 7	1 7	1 9	1 10										26
27	1 5	1 4	1 4	1 4	1 3	1 3	1 3	1 3										27
28	1 4	1 3	1 3	1 3	1 2	1 2	1 0	0 59	0 56									28
29	1 2	1 1	1 1	1 1	1 1	1 0	0 58	0 57	0 56									29
30	1 1	1 0	0 59	0 59	0 59	0 58	0 58	0 57	0 56									30
31	1 0	0 59	0 59	0 59	0 58	0 58	0 57	0 56	0 56									31
32	1 0	0 59	0 59	0 59	0 58	0 57	0 56	0 56	0 55	0 55								32
33	0 59	0 58	0 58	0 58	0 57	0 56	0 55	0 55	0 55	0 54								33
34	0 59	0 58	0 58	0 58	0 57	0 56	0 55	0 55	0 55	0 54								34
35	0 59	0 57	0 57	0 58	0 56	0 55	0 55	0 54	0 54	0 54								35
36	0 59	0 57	0 57	0 57	0 56	0 55	0 54	0 54	0 54	0 53	0 48							36
37	0 58	0 56	0 56	0 56	0 55	0 54	0 51	0 48	0 48	0 48	0 47							37
38	0 58	0 56	0 55	0 55	0 55	0 52	0 50	0 48	0 47	0 47	0 47							38
39	0 58	0 55	0 54	0 55	0 54	0 51	0 49	0 48	0 47	0 46	0 46							39
40	0 57	0 55	0 54	0 54	0 53	0 51	0 48	0 47	0 47	0 46	0 46	0 43						40
41	0 57	0 54	0 54	0 53	0 53	0 51	0 48	0 47	0 46	0 45	0 45	0 42						41
42	0 57	0 54	0 53	0 53	0 52	0 50	0 48	0 47	0 46	0 43	0 43	0 40						42
43	0 57	0 54	0 53	0 53	0 52	0 50	0 48	0 46	0 45	0 42	0 42	0 39						43
44	0 56	0 54	0 52	0 52	0 51	0 49	0 48	0 46	0 45	0 42	0 42	0 38	0 38					44
46	0 56	0 54	0 52	0 52	0 51	0 49	0 47	0 45	0 43	0 40	0 40	0 38	0 38					46
48	0 56	0 54	0 52	0 51	0 50	0 47	0 46	0 45	0 43	0 40	0 40	0 38	0 37	0 34				48
50	0 55	0 53	0 51	0 51	0 49	0 47	0 46	0 44	0 42	0 40	0 39	0 37	0 36	0 33				50
52	0 55	0 53	0 51	0 50	0 48	0 46	0 46	0 44	0 42	0 40	0 39	0 37	0 36	0 33	0 32			52
54	0 54	0 52	0 50	0 48	0 47	0 45	0 43	0 42	0 42	0 40	0 37	0 36	0 36	0 33	0 31			54
56	0 54	0 51	0 49	0 49	0 46	0 44	0 43	0 42	0 42	0 40	0 37	0 36	0 36	0 32	0 31	0 30		56
58	0 53	0 51	0 49	0 47	0 45	0 43	0 43	0 41	0 41	0 38	0 36	0 35	0 34	0 32	0 31	0 31		58
60	0 53	0 49	0 47	0 46	0 44	0 43	0 42	0 41	0 41	0 36	0 35	0 34	0 33	0 31	0 31	0 31	0 29	60
62		0 48	0 47	0 44	0 43	0 42	0 41	0 40	0 39	0 36	0 35	0 33	0 32	0 30	0 30	0 29	0 27	62
64			0 46	0 43	0 42	0 41	0 38	0 37	0 37	0 34	0 33	0 32	0 31	0 29	0 29	0 28	0 27	64
66				0 43	0 41	0 40	0 38	0 37	0 36	0 34	0 33	0 32	0 31	0 29	0 29	0 28	0 28	66
68					0 39	0 38	0 37	0 36	0 36	0 34	0 33	0 31	0 30	0 28	0 28	0 28	0 27	68
70						0 36	0 37	0 35	0 36	0 34	0 33	0 31	0 29	0 27	0 27	0 27		70
72							0 36	0 35	0 35	0 33	0 32	0 31	0 29	0 27	0 27	0 27		72
74								0 34	0 35	0 33	0 32	0 31	0 29	0 27	0 27			74
76								0 34	0 34	0 32	0 30	0 30	0 29	0 27	0 27			76
78									0 32	0 31	0 30	0 29	0 29	0 26				78
80									0 31	0 30	0 28	0 28	0 28	0 25				80
82										0 30	0 29	0 28	0 28					82
84										0 30	0 29	0 28	0 28					84
86											0 29	0 28						86

TABLE 36.

Apparent Distance, 30°

Apparent Altitude of the Sun or Star.

☾'s Alt.	6°	7°	8°	9°	10°	11°	12°	14°	16°	18°	20°	22°	24°	26°	28°	30°	32°
	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″
6°	1 12	1 11	1 15	1 23	1 31	1 42	1 53	2 27	3 2	3 8	3 37	4 4	4 31	4 56	5 25	5 51	6 17
7	1 16	1 11	1 12	1 16	1 21	1 28	1 35	1 54	2 14	2 36	2 59	3 10	3 42	4 5	4 27	4 49	5 11
8	1 21	1 13	1 11	1 12	1 14	1 18	1 22	1 37	1 52	2 10	2 30	2 48	3 6	3 27	3 44	4 3	4 21
9	1 33	1 20	1 14	1 12	1 11	1 14	1 17	1 27	1 30	1 53	2 9	2 26	2 40	2 56	3 12	3 28	3 42
10	1 43	1 27	1 19	1 13	1 10	1 11	1 12	1 18	1 28	1 39	1 52	2 5	2 18	2 31	2 45	2 59	3 13
11	1 55	1 35	1 23	1 17	1 13	1 10	1 10	1 15	1 22	1 32	1 42	1 52	2 4	2 15	2 27	2 40	2 50
12	2 9	1 46	1 32	1 23	1 16	1 13	1 11	1 12	1 16	1 22	1 32	1 40	1 59	2 0	2 10	2 19	2 30
13	2 20	1 56	1 40	1 29	1 19	1 16	1 13	1 12	1 14	1 18	1 26	1 33	1 40	1 48	1 58	2 7	2 16
14	2 33	2 4	1 48	1 34	1 23	1 18	1 15	1 12	1 12	1 13	1 19	1 24	1 30	1 37	1 46	1 43	2 0
15	2 46	2 15	1 56	1 41	1 29	1 23	1 17	1 12	1 11	1 11	1 16	1 20	1 26	1 32	1 38	1 44	1 51
16	2 59	2 27	2 5	1 49	1 35	1 27	1 19	1 13	1 11	1 10	1 12	1 15	1 19	1 23	1 29	1 35	1 41
17	3 14	2 38	2 16	1 57	1 42	1 34	1 23	1 16	1 11	1 10	1 12	1 13	1 17	1 22	1 26	1 30	1 35
18	3 26	2 50	2 24	2 5	1 49	1 39	1 28	1 16	1 10	1 9	1 9	1 10	1 12	1 14	1 17	1 22	1 26
19	3 41	3 1	2 33	2 12	1 54	1 44	1 34	1 21	1 13	1 9	1 9	1 9	1 11	1 12	1 16	1 19	1 23
20	3 55	3 12	2 43	2 20	2 2	1 50	1 39	1 24	1 14	1 9	1 7	1 7	1 8	1 9	1 12	1 15	1 18
21	4 7	3 22	2 51	2 27	2 7	1 55	1 44	1 26	1 15	1 10	1 7	1 7	1 8	1 9	1 11	1 13	1 14
22	4 20	3 31	2 59	2 34	2 12	2 0	1 49	1 27	1 17	1 10	1 6	1 7	1 7	1 7	1 8	1 9	1 10
23	4 32	3 43	3 8	2 43	2 17	2 7	1 53	1 33	1 21	1 14	1 7	1 6	1 7	1 7	1 7	1 8	1 8
24	4 46	3 54	3 18	2 51	2 25	2 11	1 58	1 36	1 24	1 17	1 8	1 6	1 6	1 4	1 5	1 6	1 7
25	4 59	4 6	3 28	2 59	2 33	2 16	2 2	1 40	1 28	1 19	1 10	1 8	1 6	1 4	1 4	1 4	1 5
26	5 13	4 15	3 38	3 7	2 40	2 21	2 5	1 43	1 30	1 19	1 12	1 9	1 4	1 3	1 3	1 3	1 4
27	5 25	4 25	3 48	3 14	2 48	2 25	2 8	1 46	1 32	1 19	1 14	1 9	1 4	1 2	1 1	1 1	1 1
28	5 37	4 36	3 58	3 22	2 54	2 29	2 14	1 52	1 33	1 21	1 15	1 10	1 5	1 2	1 1	1 1	1 1
29	5 48	4 47	4 8	3 30	3 0	2 37	2 18	1 55	1 34	1 22	1 15	1 11	1 5	1 3	1 1	1 1	1 0
30	6 1	4 59	4 18	3 39	3 7	2 44	2 25	1 59	1 38	1 24	1 19	1 11	1 6	1 3	1 2	1 1	1 0
31	6 14	5 10	4 22	3 47	2 13	2 51	2 30	2 2	1 41	1 27	1 20	1 11	1 6	1 3	1 2	1 1	1 0
32	6 26	5 19	4 29	3 51	3 21	2 58	2 35	2 6	1 43	1 30	1 20	1 11	1 8	1 4	1 2	1 1	1 0
33	6 39	5 28	4 36	3 59	3 28	3 2	2 40	2 6	1 47	1 31	1 20	1 11	1 8	1 4	1 2	1 0	1 0
34	6 52	5 38	4 44	4 4	3 33	3 9	2 46	2 13	1 50	1 32	1 20	1 11	1 8	1 4	1 2	1 0	1 0
35	7 3	5 48	4 52	4 12	3 40	3 14	2 50	2 17	1 53	1 36	1 23	1 15	1 10	1 5	1 2	1 1	1 0
36	7 13	5 59	5 2	4 20	3 46	3 20	2 55	2 20	1 57	1 39	1 26	1 18	1 10	1 7	1 3	1 1	1 0
37		6 6	5 12	4 28	3 52	3 24	2 59	2 23	2 0	1 41	1 28	1 19	1 13	1 7	1 3	1 1	1 0
38			5 25	4 35	3 59	3 30	3 4	2 28	2 3	1 44	1 30	1 20	1 14	1 9	1 5	1 2	1 0
39				4 41	4 4	3 34	3 8	2 33	2 6	1 46	1 33	1 22	1 15	1 9	1 5	1 2	1 0
40					4 10	3 38	3 12	2 38	2 9	1 48	1 35	1 24	1 16	1 10	1 6	1 3	1 0
41						3 42	3 19	2 42	2 12	1 50	1 36	1 26	1 17	1 11	1 6	1 3	1 0
42							3 23	2 43	2 15	1 52	1 38	1 27	1 18	1 11	1 7	1 3	1 0
43								2 44	2 18	1 54	1 39	1 28	1 19	1 12	1 7	1 3	1 0
44								2 45	2 20	1 56	1 41	1 29	1 19	1 12	1 7	1 3	1 0
46									2 22	1 59	1 42	1 31	1 20	1 14	1 9	1 4	1 0
48										2 2	1 46	1 32	1 21	1 15	1 9	1 4	1 0
50											1 47	1 35	1 24	1 16	1 10	1 5	1 1
52												1 37	1 26	1 17	1 11	1 6	1 1
54													1 26	1 17	1 11	1 6	1 1
56														1 17	1 11	1 7	1 1
58															1 12	1 7	1 1
60																1 7	1 1
62																	1 1
64																	
66																	
68																	
70																	
72																	
74																	
76																	
78																	
80																	
82																	

TABLE 36.

Apparent Distance, 30

Apparent Altitude of the Sun or Star.																	
34°	36°	38°	40°	42°	44°	46°	50°	54°	58°	62°	66°	70°	74°	78°	82°	86°	☾'s Alt.
′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	
6 42	7 7																6°
5 32	5 54																7
4 39	4 54	5 14															8
4 0	4 15	4 29															9
3 27	3 38	3 42	4 5														10
3 2	3 14	3 25	3 36														11
2 40	2 51	3 0	3 9	3 18													12
2 25	2 34	2 43	2 51	2 58													13
2 8	2 16	2 32	2 34	2 37	2 45												14
1 59	2 6	2 13	2 17	2 23	2 30												15
1 47	1 56	1 58	2 5	2 9	2 16	2 20											16
1 41	1 46	1 51	1 56	1 59	2 5	2 8											17
1 32	1 36	1 40	1 44	1 48	1 52	1 57											18
1 27	1 31	1 35	1 39	1 41	1 46	1 48											19
1 21	1 24	1 27	1 32	1 34	1 39	1 40	1 46										20
1 16	1 18	1 20	1 23	1 26	1 30	1 33	1 39										21
1 11	1 12	1 14	1 18	1 20	1 25	1 29	1 33										22
1 9	1 10	1 11	1 14	1 16	1 20	1 24	1 29										23
1 8	1 8	1 9	1 11	1 14	1 16	1 20	1 24	1 29									24
1 7	1 8	1 9	1 10	1 12	1 13	1 15	1 20	1 24									25
1 5	1 6	1 6	1 8	1 9	1 10	1 12	1 14	1 19									26
1 2	1 2	1 4	1 5	1 6	1 7	1 9	1 12	1 15									27
1 2	1 1	1 2	1 3	1 3	1 4	1 6	1 9	1 11	1 11								28
1 1	1 1	1 1	1 2	1 2	1 3	1 3	1 4	1 7	1 7								29
1 1	1 0	1 1	1 1	1 0	1 1	1 1	1 1	1 4	1 4								30
1 0	0 59	1 0	1 0	1 0	1 0	0 59	0 59	1 2	1 3								31
1 0	0 59	0 59	0 58	0 58	0 59	0 58	0 58	1 0	1 0	1 0							32
0 59	0 59	0 59	0 58	0 58	0 58	0 57	0 57	0 57	0 57	0 56							33
0 59	0 58	0 58	0 57	0 57	0 57	0 56	0 56	0 54	0 53	0 53							34
0 58	0 57	0 57	0 57	0 57	0 57	0 55	0 55	0 53	0 53	0 52							35
0 58	0 57	0 56	0 56	0 56	0 56	0 55	0 54	0 52	0 52	0 52	0 51						36
0 58	0 57	0 56	0 56	0 55	0 56	0 54	0 53	0 51	0 51	0 51	0 50						37
0 59	0 57	0 56	0 56	0 54	0 55	0 53	0 52	0 50	0 50	0 50	0 49						38
0 59	0 56	0 55	0 55	0 54	0 54	0 52	0 52	0 50	0 50	0 49	0 47						39
0 59	0 56	0 55	0 55	0 54	0 54	0 51	0 52	0 50	0 49	0 48	0 46	0 46					40
0 59	0 56	0 55	0 55	0 53	0 53	0 51	0 51	0 50	0 49	0 47	0 45	0 45					41
0 59	0 56	0 55	0 55	0 53	0 52	0 50	0 50	0 49	0 48	0 46	0 44	0 45					42
0 59	0 56	0 55	0 54	0 52	0 52	0 50	0 50	0 49	0 47	0 45	0 43	0 43					43
1 0	0 56	0 54	0 54	0 52	0 52	0 50	0 49	0 48	0 46	0 44	0 42	0 42	0 42				44
1 0	0 56	0 54	0 54	0 52	0 51	0 49	0 48	0 47	0 45	0 43	0 41	0 41	0 40				46
1 0	0 56	0 54	0 53	0 51	0 50	0 48	0 47	0 46	0 44	0 42	0 40	0 39	0 37	0 36			48
1 0	0 56	0 54	0 53	0 51	0 50	0 48	0 47	0 46	0 43	0 42	0 40	0 39	0 36	0 36			50
1 0	0 56	0 54	0 53	0 51	0 50	0 47	0 46	0 46	0 43	0 41	0 40	0 39	0 36	0 36	0 34		52
1 0	0 56	0 53	0 52	0 50	0 49	0 46	0 45	0 45	0 43	0 41	0 39	0 38	0 36	0 35	0 33		54
1 0	0 56	0 53	0 52	0 50	0 49	0 46	0 45	0 45	0 42	0 40	0 38	0 37	0 35	0 35	0 33	0 33	56
1 0	0 56	0 53	0 52	0 50	0 49	0 46	0 45	0 44	0 41	0 40	0 38	0 36	0 35	0 35	0 33	0 32	58
1 0	0 55	0 52	0 51	0 49	0 48	0 45	0 44	0 44	0 41	0 40	0 37	0 36	0 35	0 34	0 33	0 31	60
1 0	0 55	0 52	0 51	0 48	0 47	0 45	0 43	0 43	0 41	0 40	0 37	0 36	0 35	0 34	0 32	0 31	62
1 0	0 55	0 51	0 50	0 47	0 46	0 44	0 42	0 42	0 40	0 39	5 37	0 36	0 35	0 34	0 32	0 31	64
	0 55	0 51	0 50	0 46	0 46	0 43	0 41	0 41	0 40	0 39	0 37	0 36	0 35	0 34	0 31		66
		0 51	0 49	0 45	0 45	0 42	0 40	0 40	0 39	0 39	0 36	0 35	0 34	0 33	0 31		68
			0 49	0 45	0 44	0 41	0 39	0 39	0 39	0 39	0 36	0 35	0 34	0 32			70
				0 44	0 43	0 40	0 39	0 39	0 38	0 38	0 36	0 35	0 34	0 32			72
					0 42	0 40	0 39	0 39	0 38	0 38	0 36	0 35	0 34				74
						0 39	0 38	0 38	0 37	0 37	0 36	0 35	0 34				76
							0 38	0 38	0 36	0 36	0 35	0 35					78
							0 37	0 37	0 35	0 35	0 35	0 34					80
								0 37	0 35	0 35	0 35						82
								0 36	0 34	0 34	0 34						84
									0 34	0 34							86

TABLE 36.

Apparent Distance, 34°.

Apparent Altitude of the Sun or Star.

☾'s Alt.	6°	7°	8°	9°	10°	11°	12°	14°	16°	18°	20°	22°	24°	26°	28°	30°	32°	☾'s Alt.
	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	
6°	1 11	1 11	1 13	1 18	1 28	1 37	1 48	2 10	2 37	2 56	3 20	3 45	4 11	4 36	5 0	5 24	5 47	6
7	1 17	1 10	1 12	1 15	1 20	1 24	1 36	1 49	2 8	2 28	2 49	3 8	3 28	3 50	4 11	4 31	4 51	7
8	1 22	1 12	1 9	1 10	1 13	1 16	1 21	1 34	1 49	2 6	2 23	2 39	2 57	3 15	3 32	3 50	4 7	8
9	1 28	1 14	1 10	1 7	1 9	1 11	1 13	1 22	1 33	1 47	2 2	2 17	2 32	2 48	3 3	3 17	3 33	9
10	1 36	1 18	1 15	1 10	1 9	1 8	1 10	1 16	1 25	1 36	1 48	2 0	2 13	2 26	2 39	2 51	3 4	10
11	1 47	1 23	1 21	1 14	1 13	1 9	1 9	1 11	1 16	1 25	1 35	1 46	1 51	2 8	2 19	2 30	2 41	11
12	1 58	1 34	1 27	1 18	1 14	1 11	1 9	1 10	1 14	1 22	1 28	1 36	1 46	1 56	2 5	2 14	2 23	12
13	2 9	1 46	1 33	1 23	1 17	1 12	1 10	1 9	1 11	1 16	1 21	1 27	1 35	1 44	1 53	2 0	2 9	13
14	2 21	1 57	1 40	1 28	1 21	1 14	1 11	1 8	1 7	1 12	1 16	1 22	1 28	1 36	1 43	1 50	1 58	14
15	2 34	2 7	1 49	1 35	1 28	1 19	1 13	1 9	1 7	1 10	1 14	1 17	1 23	1 29	1 36	1 41	1 48	15
16	2 47	2 18	1 57	1 43	1 33	1 24	1 18	1 11	1 9	1 10	1 13	1 16	1 21	1 25	1 31	1 36	1 40	16
17	2 59	2 29	2 6	1 50	1 38	1 28	1 20	1 13	1 8	1 7	1 9	1 12	1 15	1 18	1 22	1 27	1 32	17
18	3 10	2 40	2 15	1 57	1 43	1 32	1 24	1 14	1 9	1 7	1 8	1 11	1 13	1 16	1 18	1 22	1 25	18
19	3 22	2 49	2 25	2 4	1 49	1 36	1 28	1 17	1 10	1 8	1 8	1 11	1 12	1 14	1 16	1 19	1 22	19
20	3 35	3 0	2 35	2 10	1 54	1 40	1 31	1 20	1 12	1 9	1 7	1 7	1 10	1 11	1 13	1 14	1 17	20
21	3 47	3 10	2 44	2 14	2 1	1 44	1 35	1 24	1 15	1 10	1 8	1 7	1 8	1 10	1 11	1 13	1 15	21
22	3 59	3 20	2 53	2 23	2 8	1 50	1 41	1 26	1 17	1 11	1 8	1 6	1 7	1 7	1 8	1 9	1 11	22
23	4 11	3 30	3 1	2 30	2 16	1 58	1 46	1 30	1 19	1 13	1 9	1 6	1 6	1 6	1 7	1 8	1 9	23
24	4 22	3 49	3 9	2 39	2 22	2 4	1 50	1 33	1 21	1 14	1 10	1 6	1 6	1 6	1 6	1 6	1 7	24
25	4 35	3 51	3 18	2 48	2 29	2 10	1 56	1 36	1 23	1 15	1 10	1 7	1 6	1 5	1 5	1 5	1 6	25
26	4 47	4 0	3 27	2 56	2 35	2 15	2 0	1 39	1 25	1 16	1 11	1 7	1 6	1 5	1 5	1 1	1 2	26
27	4 59	4 11	3 37	3 3	2 40	2 21	2 6	1 44	1 30	1 18	1 13	1 9	1 6	1 4	1 4	1 1	1 2	27
28	5 11	4 21	3 46	3 10	2 47	2 26	2 10	1 48	1 33	1 21	1 15	1 9	1 7	1 4	1 4	1 1	1 2	28
29	5 22	4 30	3 51	3 18	2 55	2 30	2 14	1 52	1 35	1 23	1 16	1 10	1 7	1 4	1 4	1 0	1 0	29
30	5 33	4 39	4 0	3 26	3 2	2 35	2 19	1 55	1 37	1 25	1 17	1 11	1 7	1 4	1 4	1 0	0 59	30
31	5 45	4 48	4 9	3 32	3 8	2 40	2 25	1 59	1 41	1 27	1 19	1 13	1 9	1 6	1 4	1 0	0 59	31
32	5 56	4 58	4 18	3 39	3 12	2 45	2 31	2 3	1 45	1 32	1 21	1 14	1 10	1 6	1 4	1 0	0 59	32
33	6 6	5 6	4 25	3 44	3 16	2 50	2 37	2 7	1 49	1 34	1 22	1 16	1 10	1 6	1 4	1 0	0 59	33
34	6 16	5 15	4 33	3 50	3 22	2 56	2 42	2 10	1 51	1 37	1 24	1 17	1 11	1 7	1 4	1 1	0 59	34
35	6 27	5 25	4 41	3 56	3 29	3 2	2 48	2 14	1 53	1 39	1 27	1 18	1 12	1 7	1 5	1 1	1 1	35
36	6 38	5 34	4 50	4 2	3 36	3 10	2 52	2 18	1 55	1 41	1 29	1 19	1 13	1 8	1 5	1 1	1 1	36
37	6 50	5 44	4 58	4 10	3 40	3 15	2 56	2 22	1 58	1 43	1 30	1 20	1 14	1 8	1 6	1 1	1 1	37
38	7 0	5 53	5 6	4 16	3 46	3 20	2 59	2 24	2 0	1 44	1 32	1 21	1 15	1 9	1 6	1 1	1 1	38
39	7 9	6 3	5 15	4 22	3 52	3 26	3 1	2 27	2 2	1 45	1 33	1 22	1 16	1 9	1 6	1 1	1 1	39
40	7 19	6 8	5 20	4 28	3 59	3 32	3 4	2 30	2 5	1 46	1 34	1 23	1 17	1 10	1 7	1 1	1 1	40
41		6 15	5 25	4 34	4 4	3 38	3 7	2 33	2 8	1 48	1 36	1 25	1 18	1 12	1 7	1 2	1 1	41
42			5 31	4 40	4 10	3 42	3 10	2 36	2 11	1 51	1 37	1 26	1 19	1 13	1 8	1 2	1 1	42
43				4 46	4 15	3 46	3 14	2 40	2 14	1 55	1 39	1 27	1 20	1 14	1 9	1 3	1 1	43
44					4 20	3 50	3 19	2 43	2 17	1 59	1 41	1 29	1 22	1 15	1 9	1 3	1 1	44
46							3 23	2 47	2 20	2 1	1 44	1 32	1 23	1 16	1 10	1 4	1 1	46
48								2 51	2 23	2 3	1 47	1 34	1 24	1 17	1 11	1 5	1 1	48
50									2 28	2 6	1 50	1 37	1 26	1 18	1 12	1 6	1 1	50
52										2 10	1 53	1 39	1 28	1 19	1 13	1 7	1 2	52
54											1 55	1 40	1 29	1 20	1 14	1 7	1 2	54
56												1 42	1 30	1 21	1 15	1 8	1 3	56
58													1 32	1 22	1 16	1 9	1 4	58
60														1 23	1 17	1 10	1 5	60
62															1 18	1 11	1 6	62
64																1 12	1 7	64
66																	1 8	66
68																		68
70																		70
72																		72
74																		74
76																		76
78																		78
80																		80
82																		82
84																		84
86																		86
	6°	7°	8°	9°	10°	11°	12°	14°	16°	18°	20°	22°	24°	26°	28°	30°	32°	

TABLE 86.

APPARENT DISTANCE, 34°

Apparent Altitude of the Sun or Star.

34°	36°	38°	40°	42°	44°	46°	50°	54°	58°	62°	66°	70°	74°	78°	82°	86°	☾'s Alt.
′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	
6 11	6 38	6 56	7 19														6°
5 10	5 30	5 49	6 6														7
4 24	4 39	4 55	5 10	5 25													8
3 49	4 3	4 18	4 30	4 41													9
3 17	3 29	3 38	3 52	4 3	4 14												10
2 52	3 3	3 14	3 25	3 34	3 44												11
2 33	2 42	2 52	3 1	3 10	3 19	3 27											12
2 18	2 26	2 35	2 43	2 51	2 58	3 5											13
2 6	2 13	2 21	2 27	2 33	2 39	2 44											14
1 55	2 1	2 8	2 13	2 17	2 22	2 29											15
1 49	1 54	2 0	2 6	2 11	2 16	2 20	2 28										16
1 38	1 42	1 52	1 53	1 58	2 3	2 7	2 15										17
1 31	1 34	1 40	1 44	1 49	1 53	1 59	2 4										18
1 26	1 29	1 36	1 38	1 42	1 46	1 50	1 56										19
1 22	1 24	1 28	1 31	1 34	1 38	1 41	1 48	1 53									20
1 18	1 21	1 24	1 27	1 30	1 33	1 35	1 41	1 47									21
1 14	1 16	1 20	1 22	1 24	1 26	1 29	1 34	1 39									22
1 12	1 14	1 17	1 19	1 21	1 22	1 24	1 30	1 34									23
1 10	1 11	1 13	1 14	1 16	1 17	1 18	1 23	1 27	1 28								24
1 8	1 9	1 11	1 12	1 14	1 15	1 17	1 20	1 22	1 24								25
1 4	1 5	1 7	1 8	1 9	1 10	1 12	1 15	1 18	1 20								26
1 3	1 5	1 6	1 7	1 8	1 9	1 10	1 13	1 16	1 18								27
1 3	1 3	1 4	1 4	1 5	1 6	1 7	1 9	1 12	1 16	1 16							28
1 1	1 1	1 2	1 2	1 3	1 4	1 4	1 7	1 9	1 9	1 12							29
0 59	1 0	1 1	1 1	1 1	1 1	1 2	1 4	1 6	1 5	1 8							30
0 59	1 0	1 1	1 1	1 1	1 1	1 1	1 3	1 5	1 4	1 7							31
0 59	0 59	1 0	1 0	1 0	1 0	1 0	1 1	1 3	1 4	1 4	1 5						32
0 59	0 59	0 59	0 59	0 59	0 59	0 59	0 59	0 59	0 59	1 2	1 2						33
0 59	0 59	0 59	0 59	0 59	0 59	0 59	0 58	0 58	0 57	0 57	0 57						34
0 59	0 59	0 59	0 59	0 59	0 58	0 58	0 58	0 57	0 56	0 56	0 56						35
1 0	0 59	0 59	0 59	0 59	0 57	0 58	0 57	0 57	0 56	0 56	0 56	0 56					36
1 0	0 59	0 59	0 59	0 59	0 57	0 57	0 57	0 56	0 56	0 56	0 56	0 55					37
1 0	0 59	0 59	0 58	0 58	0 56	0 56	0 56	0 55	0 55	0 55	0 55	0 54					38
1 0	0 58	0 58	0 58	0 58	0 55	0 55	0 55	0 54	0 54	0 54	0 54	0 53					39
1 0	0 58	0 57	0 58	0 57	0 55	0 55	0 54	0 53	0 53	0 53	0 53	0 52	0 51				40
1 0	0 57	0 57	0 57	0 57	0 54	0 54	0 53	0 52	0 52	0 52	0 52	0 51	0 50				41
1 0	0 57	0 57	0 57	0 56	0 54	0 54	0 52	0 51	0 50	0 50	0 50	0 50	0 49				42
1 0	0 57	0 57	0 56	0 56	0 54	0 53	0 51	0 51	0 50	0 50	0 50	0 49	0 48				43
1 0	0 57	0 57	0 56	0 55	0 54	0 53	0 50	0 50	0 49	0 49	0 49	0 48	0 47	0 47			44
1 0	0 57	0 57	0 56	0 54	0 53	0 52	0 50	0 49	0 48	0 48	0 48	0 47	0 46	0 46			46
1 0	0 57	0 57	0 56	0 54	0 52	0 51	0 49	0 48	0 47	0 46	0 46	0 46	0 45	0 45	0 45		48
1 0	0 57	0 57	0 55	0 53	0 51	0 50	0 48	0 47	0 46	0 45	0 45	0 45	0 44	0 44	0 44		50
1 0	0 57	0 57	0 55	0 53	0 51	0 50	0 48	0 46	0 45	0 44	0 44	0 44	0 43	0 43	0 43	0 43	52
1 0	0 57	0 57	0 55	0 52	0 50	0 49	0 47	0 45	0 44	0 43	0 43	0 43	0 42	0 42	0 42	0 42	54
1 0	0 56	0 56	0 54	0 52	0 50	0 49	0 47	0 45	0 43	0 42	0 42	0 42	0 41	0 41	0 41	0 41	56
1 1	0 56	0 56	0 54	0 51	0 50	0 48	0 47	0 45	0 42	0 41	0 41	0 41	0 40	0 40	0 40	0 40	58
1 1	0 56	0 56	0 54	0 51	0 50	0 48	0 46	0 45	0 41	0 41	0 40	0 40	0 40	0 39	0 39	0 39	60
1 1	0 56	0 56	0 54	0 51	0 50	0 48	0 46	0 44	0 41	0 41	0 40	0 40	0 39	0 38	0 38		62
1 1	0 56	0 56	0 53	0 50	0 49	0 47	0 45	0 43	0 40	0 40	0 39	0 39	0 38	0 37	0 37		64
1 1	0 56	0 56	0 53	0 50	0 49	0 47	0 44	0 43	0 40	0 40	0 39	0 39	0 37	0 36			66
1 1	0 55	0 56	0 53	0 49	0 48	0 46	0 44	0 42	0 39	0 39	0 38	0 38	0 36	0 35			68
	0 55	0 55	0 52	0 49	0 48	0 45	0 44	0 42	0 38	0 39	0 38	0 37	0 35				70
		0 55	0 52	0 49	0 47	0 45	0 43	0 42	0 37	0 38	0 37	0 37	0 34				72
			0 52	0 49	0 47	0 45	0 43	0 42	0 36	0 38	0 37	0 36					74
				0 49	0 47	0 44	0 42	0 41	0 35	0 37	0 36	0 36					76
					0 47	0 44	0 42	0 40	0 35	0 36	0 36						78
						0 44	0 42	0 40	0 35	0 35	0 35						80
							0 42	0 40	0 35	0 35							82
							0 41	0 39	0 34	0 33							84
								0 39	0 34								86

TABLE 36.

Apparent Distance, 38°

Apparent Altitude of the Sun or Star.

☽'s Alt.	6°	7°	8°	9°	10°	11°	12°	14°	16°	18°	20°	22°	24°	26°	28°	30°	32°	☽'s Alt.
	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	
6°	1 18	1 14	1 16	1 22	1 27	1 36	1 44	2 4	2 25	2 47	3 12	3 32	3 57	4 18	4 42	5 5	5 26	6°
7	1 16	1 12	1 14	1 17	1 21	1 28	1 34	1 50	2 8	2 26	2 44	3 4	3 24	3 45	4 4	4 25	4 43	7
8	1 19	1 15	1 11	1 12	1 13	1 18	1 22	1 34	1 46	2 1	2 16	2 30	2 47	3 4	3 21	3 36	4 23	8
9	1 26	1 20	1 15	1 12	1 11	1 13	1 17	1 26	1 37	1 49	2 1	2 14	2 27	2 44	2 58	3 13	3 26	9
10	1 34	1 24	1 17	1 12	1 9	1 10	1 12	1 16	1 25	1 34	1 44	1 56	2 9	2 21	2 41	2 53	3 5	10
11	1 45	1 33	1 24	1 17	1 12	1 12	1 12	1 15	1 21	1 30	1 39	1 47	1 59	2 8	2 20	2 30	2 39	11
12	1 56	1 42	1 30	1 21	1 15	1 14	1 9	1 12	1 17	1 23	1 29	1 36	1 44	1 52	2 2	2 12	2 21	12
13	2 6	1 51	1 37	1 26	1 18	1 16	1 13	1 12	1 14	1 18	1 23	1 30	1 36	1 44	1 53	2 2	2 9	13
14	2 16	2 0	1 44	1 32	1 22	1 18	1 14	1 12	1 12	1 15	1 19	1 24	1 30	1 37	1 44	1 53	2 1	14
15	2 27	2 8	1 51	1 37	1 26	1 21	1 17	1 13	1 11	1 12	1 16	1 19	1 23	1 29	1 36	1 44	1 50	15
16	2 38	2 15	1 58	1 42	1 31	1 24	1 19	1 14	1 8	1 9	1 12	1 14	1 19	1 23	1 29	1 35	1 42	16
17	2 49	2 23	2 8	1 58	1 36	1 29	1 23	1 15	1 12	1 11	1 12	1 12	1 14	1 18	1 23	1 29	1 33	17
18	3 1	2 33	2 18	2 6	1 42	1 35	1 28	1 19	1 14	1 12	1 11	1 10	1 12	1 15	1 19	1 24	1 27	18
19	3 12	2 42	2 26	2 12	1 47	1 38	1 32	1 21	1 16	1 12	1 11	1 9	1 12	1 12	1 15	1 20	1 22	19
20	3 24	2 53	2 34	2 17	1 52	1 43	1 36	1 24	1 18	1 13	1 11	1 8	1 8	1 9	1 12	1 16	1 17	20
21	3 34	3 3	2 42	2 23	1 57	1 48	1 40	1 26	1 19	1 14	1 11	1 7	1 6	1 6	1 8	1 11	1 13	21
22	3 46	3 14	2 50	2 29	2 3	1 54	1 44	1 29	1 20	1 14	1 9	1 6	1 6	1 5	1 7	1 10	1 10	22
23	3 56	3 23	2 58	2 35	2 9	2 0	1 47	1 31	1 21	1 14	1 9	1 6	1 4	1 4	1 4	1 7	1 7	23
24	4 8	3 32	3 6	2 40	2 15	2 6	1 51	1 34	1 23	1 15	1 9	1 6	1 4	1 3	1 3	1 5	1 4	24
25	4 20	3 40	3 12	2 46	2 21	2 12	1 55	1 37	1 24	1 16	1 9	1 5	1 3	1 3	1 3	1 3	1 3	25
26	4 32	3 51	3 20	2 50	2 26	2 17	2 0	1 41	1 27	1 17	1 9	1 5	1 3	1 3	1 3	1 3	1 3	26
27	4 43	4 3	3 28	2 57	2 33	2 23	2 5	1 44	1 30	1 18	1 9	1 6	1 2	1 1	1 2	1 2	1 3	27
28	4 54	4 11	3 36	3 4	2 40	2 28	2 10	1 49	1 33	1 20	1 10	1 7	1 2	1 1	1 2	1 2	1 3	28
29	5 5	4 21	3 45	3 10	2 46	2 33	2 15	1 56	1 37	1 22	1 10	1 8	1 1	1 0	1 2	1 2	1 3	29
30	5 16	4 33	3 51	3 17	2 53	2 37	2 20	2 0	1 40	1 24	1 12	1 9	1 1	1 0	1 2	1 3	1 3	30
31	5 27	4 40	3 57	3 25	3 0	2 41	2 25	2 4	1 42	1 26	1 14	1 11	1 2	1 0	1 1	1 3	1 3	31
32	5 38	4 50	4 5	3 32	3 5	2 46	2 29	2 7	1 44	1 29	1 16	1 14	1 3	1 1	1 1	1 4	1 2	32
33	5 48	5 1	4 12	3 38	3 11	2 51	2 33	2 10	1 46	1 32	1 19	1 16	1 6	1 2	1 1	1 4	1 1	33
34	5 59	5 13	4 19	3 44	3 17	2 56	2 37	2 13	1 48	1 34	1 21	1 17	1 8	1 3	1 1	1 4	1 1	34
35	6 10	5 20	4 26	3 50	3 23	3 1	2 42	2 16	1 51	1 37	1 22	1 18	1 10	1 5	1 2	1 4	1 1	35
36	6 20	5 27	4 32	3 56	3 28	3 5	2 46	2 19	1 53	1 39	1 24	1 20	1 11	1 6	1 2	1 4	1 1	36
37	6 28	5 33	4 39	4 2	3 34	3 10	2 50	2 22	1 56	1 40	1 25	1 22	1 12	1 7	1 2	1 4	1 1	37
38	6 36	5 40	4 45	4 10	3 38	3 15	2 54	2 26	1 59	1 42	1 27	1 24	1 16	1 8	1 3	1 4	1 0	38
39	6 46	5 48	4 51	4 15	3 43	3 19	2 58	2 29	2 2	1 44	1 30	1 25	1 17	1 9	1 4	1 4	1 0	39
40	6 54	5 55	4 57	4 20	3 47	3 23	3 2	2 32	2 4	1 45	1 32	1 26	1 18	1 10	1 5	1 4	1 0	40
41	7 2	6 3	5 3	4 24	3 51	3 27	3 6	2 34	2 7	1 48	1 34	1 27	1 19	1 11	1 6	1 4	1 0	41
42	7 10	6 10	5 10	4 30	3 56	3 32	3 9	2 36	2 10	1 50	1 36	1 29	1 20	1 12	1 7	1 5	1 1	42
43	7 19	6 16	5 16	4 35	4 0	3 35	3 13	2 39	2 13	1 53	1 38	1 30	1 21	1 13	1 8	1 6	1 1	43
44	7 28	6 20	5 22	4 40	4 6	3 40	3 17	2 42	2 16	1 56	1 41	1 31	1 22	1 15	1 9	1 6	1 1	44
46			5 30	4 50	4 13	3 47	3 23	2 47	2 19	1 59	1 43	1 33	1 23	1 16	1 10	1 7	1 2	46
48					4 22	3 54	3 30	2 52	2 23	2 2	1 46	1 35	1 25	1 17	1 11	1 8	1 3	48
50							3 36	2 56	2 26	2 7	1 50	1 37	1 27	1 19	1 13	1 9	1 4	50
52								3 0	2 30	2 11	1 54	1 40	1 30	1 21	1 15	1 10	1 5	52
54									2 34	2 14	1 57	1 42	1 31	1 22	1 16	1 11	1 6	54
56										2 17	1 59	1 44	1 32	1 23	1 17	1 12	1 7	56
58											2 0	1 47	1 35	1 25	1 18	1 13	1 8	58
60												1 49	1 38	1 27	1 20	1 14	1 9	60
62													1 39	1 28	1 21	1 15	1 10	62
64														1 30	1 22	1 16	1 11	64
66															1 23	1 17	1 11	66
68																	1 11	68
70																	1 11	70
72																		72
74																		74
76																		76
78																		78
80																		80
82																		82
84																		84
86																		86
	6°	7°	8°	9°	10°	11°	12°	14°	16°	18°	20°	22°	24°	26°	28°	30°	32°	

TABLE 36.

APPARENT DISTANCE, 38°

Apparent Altitude of the Sun or Star.

’s lt.	34°	36°	38°	40°	42°	44°	46°	50°	54°	58°	62°	66°	70°	74°	78°	82°	86°	
	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	
6°	6 48	6 7	6 27	6 48	7 9	7 29												6
7	5 3	5 20	5 39	5 58	6 17	6 36												7
8	4 9	4 24	4 39	4 53	5 6	5 20	5 36											8
9	3 41	3 54	4 7	4 19	4 31	4 40	4 51											9
10	3 7	3 18	3 30	3 41	3 51	4 2	4 12											10
11	2 51	3 1	3 12	3 21	3 30	3 39	3 47											11
12	2 30	2 40	2 50	2 58	3 4	3 10	3 18	3 36										12
13	2 19	2 27	2 36	2 44	2 52	2 58	3 2	3 14										13
14	2 9	2 16	2 24	2 31	2 37	2 43	2 48	2 58										14
15	1 57	2 3	2 10	2 17	2 22	2 29	2 36	2 44										15
16	1 46	1 51	1 57	2 2	2 6	2 12	2 17	2 26	2 36									16
17	1 39	1 44	1 50	1 55	1 59	2 4	2 8	2 18	2 25									17
18	1 33	1 38	1 43	1 48	1 51	1 55	2 0	2 7	2 12									18
19	1 27	1 31	1 35	1 39	1 43	1 47	1 51	1 57	2 2									19
20	1 21	1 24	1 26	1 32	1 36	1 39	1 42	1 47	1 53	1 59								20
21	1 16	1 19	1 24	1 27	1 30	1 33	1 35	1 40	1 46	1 51								21
22	1 12	1 16	1 20	1 23	1 25	1 28	1 30	1 34	1 40	1 44								22
23	1 8	1 11	1 15	1 18	1 20	1 22	1 24	1 28	1 34	1 37								23
24	1 5	1 8	1 12	1 15	1 16	1 18	1 20	1 24	1 28	1 31	1 37							24
25	1 5	1 7	1 11	1 12	1 14	1 16	1 18	1 21	1 25	1 27	1 33							25
26	1 4	1 6	1 8	1 10	1 11	1 13	1 15	1 18	1 21	1 23	1 30							26
27	1 4	1 5	1 6	1 8	1 9	1 11	1 12	1 15	1 17	1 19	1 24							27
28	1 4	1 4	1 5	1 7	1 7	1 9	1 10	1 12	1 14	1 16	1 19	1 22						28
29	1 3	1 3	1 4	1 6	1 6	1 7	1 7	1 9	1 12	1 13	1 15	1 18						29
30	1 3	1 2	1 3	1 5	1 5	1 6	1 6	1 8	1 10	1 11	1 13	1 15						30
31	1 3	1 2	1 3	1 4	1 4	1 5	1 5	1 7	1 8	1 10	1 11	1 13						31
32	1 2	1 1	1 1	1 3	1 3	1 4	1 4	1 6	1 6	1 7	1 9	1 9	1 10					32
33	1 1	1 1	1 0	1 2	1 2	1 3	1 3	1 5	1 5	1 6	1 6	1 6	1 6					33
34	1 1	1 1	1 0	1 1	1 2	1 2	1 2	1 4	1 4	1 4	1 4	1 4	1 4					34
35	1 0	0 59	0 58	0 58	0 58	0 58	0 59	1 1	1 1	1 1	1 1	1 1	0 59					35
36	1 0	0 59	0 58	0 58	0 58	0 58	0 58	0 58	0 57	0 57	0 58	0 58	0 59	0 59				36
37	1 0	0 59	0 58	0 58	0 57	0 57	0 57	0 57	0 57	0 57	0 58	0 58	0 58	0 59				37
38	1 0	0 59	0 58	0 58	0 57	0 57	0 57	0 57	0 56	0 56	0 57	0 57	0 57	0 57				38
39	1 0	0 59	0 58	0 58	0 57	0 57	0 56	0 56	0 55	0 55	0 56	0 56	0 56	0 56				39
40	1 0	0 58	0 57	0 57	0 56	0 56	0 55	0 55	0 54	0 54	0 54	0 54	0 54	0 53	0 53			40
41	1 0	0 58	0 57	0 57	0 56	0 56	0 54	0 54	0 53	0 53	0 53	0 33	0 53	0 52	0 52			41
42	1 0	0 58	0 57	0 57	0 56	0 56	0 54	0 53	0 52	0 52	0 52	0 52	0 52	0 51	0 51			42
43	1 1	0 59	0 56	0 57	0 56	0 56	0 53	0 53	0 52	0 52	0 52	0 52	0 51	0 50	0 50			43
44	1 1	0 58	0 56	0 57	0 56	0 56	0 53	0 52	0 51	0 51	0 51	0 51	0 50	0 49	0 49	0 49		44
46	1 1	0 58	0 56	0 57	0 56	0 56	0 53	0 52	0 50	0 50	0 50	0 50	0 49	0 48	0 48	0 48		46
48	1 1	0 58	0 56	0 57	0 56	0 55	0 53	0 52	0 50	0 50	0 49	0 49	0 48	0 47	0 47	0 47	0 47	48
50	1 2	0 58	0 57	0 57	0 56	0 55	0 53	0 51	0 50	0 49	0 48	0 48	0 47	0 46	0 46	0 46	0 46	50
52	1 2	1 0	0 58	0 56	0 56	0 55	0 53	0 51	0 50	0 49	0 47	0 47	0 46	0 45	0 45	0 45	0 45	52
54	1 3	1 0	0 58	0 56	0 56	0 54	0 52	0 50	0 49	0 48	0 46	0 46	0 44	0 44	0 44	0 44	0 44	54
56	1 4	1 0	0 58	0 56	0 56	0 54	0 52	0 50	0 49	0 47	0 45	0 45	0 43	0 43	0 43	0 43	0 43	56
58	1 5	1 1	0 58	0 57	0 56	0 54	0 52	0 50	0 48	0 47	0 45	0 44	0 43	0 42	0 42	0 42		58
60	1 6	1 1	0 59	0 57	0 56	0 54	0 52	0 50	0 47	0 47	0 44	0 43	0 42	0 41	0 41	0 41		60
62	1 7	1 1	0 59	0 57	0 56	0 54	0 52	0 49	0 47	0 46	0 44	0 42	0 41	0 41	0 40			62
64	1 7	1 2	0 59	0 57	0 55	0 53	0 51	0 49	0 46	0 46	0 43	0 41	0 40	0 39	0 40			64
66	1 7	1 2	0 59	0 57	0 55	0 53	0 51	0 49	0 46	0 44	0 43	0 41	0 40	0 38				66
68	1 7	1 2	0 59	0 57	0 54	0 52	0 50	0 48	0 45	0 43	0 43	0 40	0 39	0 37				68
70	1 7	1 2	0 59	0 57	0 54	0 52	0 50	0 48	0 45	0 42	0 42	0 40	0 39					70
72	1 7	1 2	0 59	0 57	0 54	0 52	0 50	0 48	0 45	0 42	0 41	0 40	0 39					72
74		1 2	0 59	0 57	0 54	0 52	0 50	0 47	0 45	0 42	0 40	0 40						74
76			0 59	0 57	0 54	0 52	0 50	0 47	0 45	0 41	0 40	0 40						76
78				0 57	0 54	0 52	0 50	0 47	0 45	0 41	0 40							78
80					0 54	0 52	0 50	0 46	0 45	0 41	0 39							80
82						0 52	0 50	0 46	0 45	0 41								82
84							0 50	0 46	0 44	0 41								84
86								0 46	0 44									86
	34°	36°	38°	40°	42°	44°	46°	50°	54°	58°	62°	66°	70°	74°	78°	82°	86°	

TABLE 36.

APPARENT DISTANCE, 38°

Apparent Altitude of the Sun or Star.

☽'s Alt.	6°	7°	8°	9°	10°	11°	12°	14°	16°	18°	20°	22°	24°	26°	28°	30°	32°
	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″
6°	1 18	1 14	1 16	1 22	1 27	1 36	1 44	2 4	2 25	2 47	3 12	3 32	3 57	4 18	4 42	5 5	5 26
7	1 16	1 12	1 14	1 17	1 21	1 28	1 34	1 50	2 8	2 26	2 44	3 4	3 24	3 45	4 4	4 25	4 43
8	1 19	1 15	1 11	1 12	1 13	1 18	1 22	1 34	1 46	2 1	2 16	2 30	2 47	3 4	3 21	3 36	4 23
9	1 26	1 20	1 15	1 12	1 11	1 13	1 17	1 26	1 37	1 49	2 1	2 14	2 27	2 44	2 58	3 13	3 26
10	1 34	1 24	1 17	1 12	1 9	1 10	1 12	1 16	1 25	1 34	1 44	1 56	2 9	2 21	2 41	2 53	3 5
11	1 45	1 33	1 24	1 17	1 12	1 12	1 12	1 15	1 21	1 30	1 39	1 47	1 59	2 8	2 20	2 30	2 39
12	1 56	1 42	1 30	1 21	1 15	1 14	1 9	1 12	1 17	1 23	1 29	1 36	1 44	1 52	2 2	2 12	2 21
13	2 6	1 51	1 37	1 26	1 18	1 16	1 13	1 12	1 14	1 18	1 23	1 30	1 36	1 44	1 53	2 2	2 9
14	2 16	2 0	1 44	1 32	1 22	1 18	1 14	1 12	1 12	1 15	1 19	1 24	1 30	1 37	1 44	1 53	2 1
15	2 27	2 8	1 51	1 37	1 26	1 21	1 17	1 13	1 11	1 12	1 16	1 19	1 23	1 29	1 36	1 44	1 54
16	2 38	2 15	1 58	1 42	1 31	1 24	1 19	1 14	1 8	1 9	1 12	1 14	1 19	1 23	1 29	1 35	1 42
17	2 49	2 23	2 8	1 58	1 36	1 29	1 23	1 15	1 12	1 11	1 12	1 12	1 14	1 18	1 23	1 29	1 33
18	3 1	2 33	2 18	2 6	1 42	1 35	1 28	1 19	1 14	1 12	1 11	1 10	1 12	1 15	1 19	1 24	1 27
19	3 12	2 42	2 26	2 12	1 47	1 38	1 32	1 21	1 16	1 12	1 11	1 9	1 12	1 12	1 15	1 20	1 22
20	3 24	2 53	2 34	2 17	1 52	1 43	1 36	1 24	1 18	1 13	1 11	1 8	1 8	1 9	1 12	1 16	1 17
21	3 34	3 3	2 42	2 23	1 57	1 48	1 40	1 26	1 19	1 14	1 11	1 7	1 6	1 6	1 8	1 11	1 13
22	3 46	3 14	2 50	2 29	2 3	1 54	1 44	1 29	1 20	1 14	1 9	1 6	1 5	1 5	1 7	1 10	1 10
23	3 56	3 23	2 58	2 35	2 9	2 0	1 47	1 31	1 21	1 14	1 9	1 6	1 4	1 4	1 4	1 7	1 7
24	4 8	3 32	3 6	2 40	2 15	2 6	1 51	1 34	1 23	1 15	1 9	1 6	1 4	1 3	1 3	1 5	1 4
25	4 20	3 40	3 12	2 46	2 21	2 12	1 55	1 37	1 24	1 16	1 9	1 5	1 3	1 3	1 3	1 3	1 3
26	4 32	3 51	3 20	2 50	2 26	2 17	2 0	1 41	1 27	1 17	1 9	1 5	1 3	1 3	1 3	1 3	1 3
27	4 43	4 3	3 28	2 57	2 33	2 23	2 5	1 44	1 30	1 18	1 9	1 6	1 2	1 1	1 2	1 2	1 3
28	4 54	4 11	3 36	3 4	2 40	2 28	2 10	1 49	1 33	1 20	1 10	1 7	1 2	1 1	1 2	1 2	1 3
29	5 5	4 21	3 45	3 10	2 46	2 33	2 15	1 56	1 37	1 22	1 10	1 8	1 1	1 0	1 2	1 2	1 3
30	5 16	4 33	3 51	3 17	2 53	2 37	2 20	2 0	1 40	1 24	1 12	1 9	1 1	1 0	1 2	1 3	1 3
31	5 27	4 40	3 57	3 25	3 0	2 41	2 25	2 4	1 42	1 26	1 14	1 11	1 2	1 0	1 1	1 3	1 3
32	5 38	4 50	4 5	3 32	3 5	2 46	2 29	2 7	1 44	1 29	1 16	1 14	1 3	1 1	1 1	1 4	1 2
33	5 48	5 1	4 12	3 38	3 11	2 51	2 33	2 10	1 46	1 32	1 19	1 16	1 6	1 2	1 1	1 4	1 1
34	5 59	5 13	4 19	3 44	3 17	2 56	2 37	2 13	1 48	1 34	1 21	1 17	1 8	1 3	1 1	1 4	1 1
35	6 10	5 20	4 26	3 50	3 23	3 1	2 42	2 16	1 51	1 37	1 22	1 18	1 10	1 5	1 2	1 4	1 1
36	6 20	5 27	4 32	3 56	3 28	3 5	2 46	2 19	1 53	1 39	1 24	1 20	1 11	1 6	1 2	1 4	1 1
37	6 28	5 33	4 39	4 2	3 34	3 10	2 50	2 22	1 56	1 40	1 25	1 22	1 12	1 7	1 2	1 4	1 1
38	6 36	5 40	4 45	4 10	3 38	3 15	2 54	2 26	1 59	1 42	1 27	1 24	1 16	1 8	1 3	1 4	1 0
39	6 46	5 48	4 51	4 15	3 43	3 19	2 58	2 29	2 2	1 44	1 30	1 25	1 17	1 9	1 4	1 4	1 0
40	6 54	5 55	4 57	4 20	3 47	3 23	3 2	2 32	2 4	1 45	1 32	1 26	1 18	1 10	1 5	1 4	1 0
41	7 2	6 3	5 3	4 24	3 51	3 27	3 6	2 34	2 7	1 48	1 34	1 27	1 19	1 11	1 6	1 4	1 0
42	7 10	6 10	5 10	4 30	3 56	3 32	3 9	2 36	2 10	1 50	1 36	1 29	1 20	1 12	1 7	1 5	1 1
43	7 19	6 16	5 16	4 35	4 0	3 35	3 13	2 39	2 13	1 53	1 38	1 30	1 21	1 13	1 8	1 6	1 1
44	7 28	6 20	5 22	4 40	4 6	3 40	3 17	2 42	2 16	1 56	1 41	1 31	1 22	1 15	1 9	1 6	1 1
46			5 30	4 50	4 13	3 47	3 23	2 47	2 19	1 59	1 43	1 33	1 23	1 16	1 10	1 7	1 2
48					4 22	3 54	3 30	2 52	2 23	2 2	1 46	1 35	1 25	1 17	1 11	1 8	1 3
50							3 36	2 56	2 26	2 7	1 50	1 37	1 27	1 19	1 13	1 9	1 4
52								3 0	2 30	2 11	1 54	1 40	1 30	1 21	1 15	1 10	1 5
54									2 34	2 14	1 57	1 42	1 31	1 22	1 16	1 11	1 6
56										2 17	1 59	1 44	1 32	1 23	1 17	1 12	1 7
58											2 0	1 47	1 35	1 25	1 18	1 13	1 8
60												1 49	1 38	1 27	1 20	1 14	1 9
62													1 39	1 28	1 21	1 15	1 10
64														1 30	1 22	1 16	1 11
66															1 23	1 17	1 11
68																	1 11
70																	1 11
72																	
74																	
76																	
78																	
80																	
82																	
84																	
86																	

TABLE 36.

APPARENT DISTANCE, 38°

Apparent Altitude of the Sun or Star.

34°	36°	38°	40°	42°	44°	46°	50°	54°	58°	62°	66°	70°	74°	78°	82°	86°	☾'s
′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	Alt.
6 48	6 7	6 27	6 48	7 9	7 29												6°
5 3	5 20	5 39	5 58	6 17	6 36												7
4 9	4 24	4 39	4 53	5 6	5 20	5 36											8
3 41	3 54	4 7	4 19	4 31	4 40	4 51											9
3 7	3 18	3 30	3 41	3 51	4 2	4 12											10
2 51	3 1	3 12	3 21	3 30	3 39	3 47											11
2 30	2 40	2 50	2 58	3 4	3 10	3 18	3 36										12
2 19	2 27	2 36	2 44	2 52	2 58	3 2	3 14										13
2 9	2 16	2 24	2 31	2 37	2 43	2 48	2 58										14
1 57	2 3	2 10	2 17	2 22	2 29	2 36	2 44										15
1 46	1 51	1 57	2 2	2 6	2 12	2 17	2 26	2 36									16
1 39	1 44	1 50	1 55	1 59	2 4	2 8	2 18	2 25									17
1 33	1 38	1 43	1 48	1 51	1 55	2 0	2 7	2 12									18
1 27	1 31	1 35	1 39	1 43	1 47	1 51	1 57	2 2									19
1 21	1 24	1 26	1 32	1 36	1 39	1 42	1 47	1 53	1 59								20
1 16	1 19	1 24	1 27	1 30	1 33	1 35	1 40	1 46	1 51								21
1 12	1 16	1 20	1 23	1 25	1 28	1 30	1 34	1 40	1 44								22
1 8	1 11	1 15	1 18	1 20	1 22	1 24	1 28	1 34	1 37								23
1 5	1 8	1 12	1 15	1 16	1 18	1 20	1 24	1 28	1 31	1 37							24
1 5	1 7	1 11	1 12	1 14	1 16	1 18	1 21	1 25	1 27	1 33							25
1 4	1 6	1 8	1 10	1 11	1 13	1 15	1 18	1 21	1 23	1 30							26
1 4	1 5	1 6	1 8	1 9	1 11	1 12	1 15	1 17	1 19	1 24							27
1 4	1 4	1 5	1 7	1 7	1 9	1 10	1 12	1 14	1 16	1 19	1 22						28
1 3	1 3	1 4	1 6	1 6	1 7	1 7	1 9	1 12	1 13	1 15	1 18						29
1 3	1 2	1 3	1 5	1 5	1 6	1 6	1 8	1 10	1 11	1 13	1 15						30
1 3	1 2	1 3	1 4	1 4	1 5	1 5	1 7	1 8	1 10	1 11	1 13						31
1 2	1 1	1 1	1 3	1 3	1 4	1 4	1 6	1 6	1 7	1 9	1 9	1 10					32
1 1	1 1	1 0	1 2	1 2	1 3	1 3	1 5	1 5	1 6	1 6	1 6	1 6					33
1 1	1 1	1 0	1 1	1 2	1 2	1 2	1 4	1 4	1 4	1 4	1 4	1 4					34
1 0	0 59	0 58	0 58	0 58	0 58	0 59	1 1	1 1	1 1	1 1	1 1	0 59					35
1 0	0 59	0 58	0 58	0 58	0 58	0 58	0 58	0 57	0 57	0 58	0 58	0 59	0 59				36
1 0	0 59	0 58	0 58	0 57	0 57	0 57	0 57	0 57	0 57	0 58	0 58	0 58	0 59				37
1 0	0 59	0 58	0 58	0 57	0 57	0 57	0 57	0 56	0 56	0 57	0 57	0 57	0 57				38
1 0	0 59	0 58	0 58	0 57	0 57	0 56	0 56	0 55	0 55	0 56	0 56	0 56	0 56				39
1 0	0 58	0 57	0 57	0 56	0 56	0 55	0 55	0 54	0 54	0 54	0 54	0 54	0 53	0 53			40
1 0	0 58	0 57	0 57	0 56	0 56	0 54	0 54	0 53	0 53	0 53	0 53	0 53	0 52	0 52			41
1 0	0 58	0 57	0 57	0 56	0 56	0 54	0 53	0 52	0 52	0 52	0 52	0 52	0 51	0 51			42
1 1	0 59	0 56	0 57	0 56	0 56	0 53	0 53	0 52	0 52	0 52	0 52	0 51	0 50	0 50			43
1 1	0 58	0 56	0 57	0 56	0 56	0 53	0 52	0 51	0 51	0 51	0 51	0 50	0 49	0 49	0 49		44
1 1	0 58	0 56	0 57	0 56	0 56	0 53	0 52	0 50	0 50	0 50	0 50	0 49	0 48	0 48	0 48		46
1 1	0 58	0 56	0 57	0 56	0 55	0 53	0 52	0 50	0 50	0 49	0 49	0 48	0 47	0 47	0 47	0 47	48
1 2	0 58	0 57	0 57	0 56	0 55	0 53	0 51	0 50	0 49	0 48	0 48	0 47	0 46	0 46	0 46	0 46	50
1 2	1 0	0 58	0 56	0 56	0 55	0 53	0 51	0 50	0 49	0 47	0 47	0 46	0 45	0 45	0 45	0 45	52
1 3	1 0	0 58	0 56	0 56	0 54	0 52	0 50	0 49	0 48	0 46	0 46	0 44	0 44	0 44	0 44	0 44	54
1 4	1 0	0 58	0 56	0 56	0 54	0 52	0 50	0 49	0 47	0 45	0 45	0 43	0 43	0 43	0 43	0 43	56
1 5	1 1	0 58	0 57	0 56	0 54	0 52	0 50	0 48	0 47	0 45	0 44	0 43	0 42	0 42	0 42		58
1 6	1 1	0 59	0 57	0 56	0 54	0 52	0 50	0 47	0 47	0 44	0 43	0 42	0 41	0 41	0 41		60
1 7	1 1	0 59	0 57	0 56	0 54	0 52	0 49	0 47	0 46	0 44	0 42	0 41	0 41	0 40			62
1 7	1 2	0 59	0 57	0 55	0 53	0 51	0 49	0 46	0 46	0 43	0 41	0 40	0 39	0 40			64
1 7	1 2	0 59	0 57	0 55	0 53	0 51	0 49	0 46	0 44	0 43	0 41	0 40	0 38				66
1 7	1 2	0 59	0 57	0 54	0 52	0 50	0 48	0 45	0 43	0 43	0 40	0 39	0 37				68
1 7	1 2	0 59	0 57	0 54	0 52	0 50	0 48	0 45	0 42	0 42	0 40	0 39					70
1 7	1 2	0 59	0 57	0 54	0 52	0 50	0 48	0 45	0 42	0 41	0 40	0 39					72
	1 2	0 59	0 57	0 54	0 52	0 50	0 47	0 45	0 42	0 40	0 40						74
		0 59	0 57	0 54	0 52	0 50	0 47	0 45	0 41	0 40	0 40						76
			0 57	0 54	0 52	0 50	0 47	0 45	0 41	0 40							78
				0 54	0 52	0 50	0 46	0 45	0 41	0 39							80
					0 52	0 50	0 46	0 45	0 41								82
						0 50	0 46	0 44	0 41								84
							0 46	0 44									86

TABLE 36.

APPARENT DISTANCE, 42°

Apparent Altitude of the Sun or Star.

☾'s Alt.	6°	7°	8°	9°	10°	11°	12°	14°	16°	18°	20°	22°	24°	26°	28°	30°	32°
	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″
6°	1 14	1 15	1 20	1 22	1 24	1 34	1 44	2 2	2 20	2 42	3 4	3 26	3 47	4 8	4 29	4 50	5 10
7	1 19	1 16	1 18	1 20	1 22	1 28	1 33	1 47	2 2	2 19	2 37	2 54	3 12	3 30	3 47	4 6	4 21
8	1 20	1 15	1 14	1 16	1 18	1 21	1 23	1 32	1 44	2 0	2 14	2 29	2 43	2 59	3 14	3 30	3 43
9	1 30	1 22	1 17	1 13	1 16	1 18	1 19	1 27	1 37	1 48	2 0	2 11	2 24	2 37	2 50	3 2	3 16
10	1 39	1 26	1 22	1 17	1 12	1 15	1 17	1 20	1 25	1 36	1 45	1 56	2 6	2 17	2 28	2 40	2 51
11	1 46	1 34	1 26	1 20	1 17	1 14	1 16	1 18	1 20	1 24	1 34	1 44	1 54	2 3	2 13	2 23	2 33
12	1 57	1 42	1 31	1 22	1 19	1 16	1 12	1 14	1 18	1 25	1 30	1 36	1 45	1 50	2 1	2 14	2 18
13	2 8	1 50	1 34	1 26	1 20	1 18	1 16	1 13	1 17	1 20	1 24	1 30	1 35	1 46	1 53	2 0	2 8
14	2 17	1 58	1 42	1 30	1 24	1 19	1 17	1 10	1 16	1 18	1 22	1 27	1 33	1 39	1 45	1 51	1 57
15	2 27	2 6	1 49	1 36	1 29	1 20	1 18	1 12	1 14	1 16	1 19	1 23	1 27	1 32	1 37	1 43	1 48
16	2 36	2 14	1 55	1 42	1 32	1 23	1 19	1 16	1 14	1 15	1 17	1 19	1 23	1 27	1 32	1 36	1 41
17	2 48	2 22	2 2	1 48	1 35	1 26	1 20	1 17	1 15	1 12	1 15	1 17	1 20	1 23	1 26	1 30	1 35
18	2 58	2 30	2 9	1 53	1 40	1 32	1 24	1 20	1 16	1 10	1 14	1 15	1 18	1 20	1 22	1 25	1 30
19	3 10	2 39	2 16	1 58	1 45	1 37	1 29	1 22	1 17	1 12	1 13	1 14	1 16	1 17	1 19	1 22	1 25
20	3 19	2 47	2 23	2 4	1 50	1 41	1 35	1 24	1 19	1 15	1 12	1 12	1 14	1 15	1 17	1 19	1 22
21	3 30	2 56	2 31	2 10	1 56	1 45	1 38	1 27	1 20	1 16	1 13	1 12	1 13	1 14	1 15	1 17	1 19
22	3 40	3 5	2 38	2 18	2 1	1 50	1 40	1 30	1 22	1 17	1 13	1 11	1 12	1 13	1 14	1 15	1 16
23	3 50	3 14	2 46	2 24	2 7	1 54	1 43	1 33	1 24	1 18	1 14	1 12	1 11	1 11	1 12	1 13	1 14
24	4 2	3 22	2 54	2 30	2 12	2 0	1 49	1 36	1 26	1 19	1 15	1 12	1 10	1 10	1 10	1 11	1 12
25	4 12	3 31	3 1	2 37	2 18	2 4	1 51	1 39	1 28	1 20	1 16	1 13	1 10	1 9	1 9	1 10	1 11
26	4 22	3 41	3 9	2 43	2 24	2 10	1 56	1 42	1 30	1 21	1 17	1 13	1 10	1 8	1 9	1 9	1 10
27	4 33	3 49	3 16	2 50	2 30	2 16	2 0	1 46	1 32	1 22	1 18	1 14	1 11	1 9	1 8	1 8	1 9
28	4 44	3 57	3 24	2 57	2 36	2 21	2 4	1 48	1 34	1 25	1 19	1 15	1 12	1 9	1 7	1 7	1 8
29	4 54	4 6	3 31	3 2	2 42	2 24	2 9	1 51	1 37	1 27	1 20	1 15	1 12	1 9	1 7	1 6	1 7
30	5 4	4 14	3 39	3 9	2 47	2 30	2 12	1 54	1 39	1 28	1 21	1 16	1 13	1 9	1 7	1 6	1 6
31	5 14	4 23	3 46	3 14	2 52	2 35	2 16	1 57	1 41	1 29	1 22	1 17	1 13	1 10	1 8	1 6	1 6
32	5 21	4 31	3 53	3 22	2 58	2 39	2 20	2 0	1 43	1 30	1 23	1 18	1 14	1 10	1 8	1 6	1 5
33	5 32	4 39	4 0	3 26	3 2	2 43	2 24	2 3	1 45	1 32	1 24	1 19	1 15	1 11	1 9	1 7	1 5
34	5 42	4 47	4 7	3 33	3 7	2 46	2 30	2 6	1 48	1 35	1 26	1 20	1 15	1 11	1 9	1 7	1 5
35	5 52	4 55	4 14	3 40	3 12	2 50	2 34	2 9	1 50	1 37	1 27	1 21	1 16	1 12	1 9	1 7	1 5
36	6 0	5 2	4 20	3 46	3 16	2 54	2 38	2 13	1 53	1 39	1 28	1 22	1 17	1 13	1 9	1 7	1 5
37	6 9	5 10	4 26	3 52	3 21	3 0	2 42	2 16	1 56	1 41	1 30	1 22	1 17	1 13	1 10	1 8	1 6
38	6 18	5 17	4 32	3 57	3 26	3 7	2 46	2 19	1 59	1 43	1 32	1 24	1 18	1 14	1 10	1 8	1 6
39	6 27	5 24	4 38	4 3	3 32	3 11	2 50	2 22	2 1	1 45	1 34	1 25	1 19	1 14	1 11	1 8	1 6
40	6 36	5 31	4 44	4 8	3 37	3 15	2 56	2 25	2 4	1 47	1 36	1 27	1 20	1 15	1 11	1 8	1 6
41	6 45	5 38	4 50	4 13	3 42	3 20	3 0	2 28	2 7	1 49	1 38	1 28	1 21	1 16	1 12	1 9	1 7
42	6 53	5 45	4 56	4 18	3 46	3 24	3 3	2 31	2 9	1 51	1 40	1 29	1 22	1 16	1 12	1 9	1 7
43	7 2	5 52	5 2	4 23	3 50	3 28	3 7	2 34	2 11	1 53	1 42	1 30	1 23	1 17	1 13	1 9	1 7
44	7 8	5 59	5 9	4 28	3 55	3 32	3 10	2 37	2 13	1 55	1 44	1 32	1 24	1 18	1 13	1 10	1 7
46	7 23	6 13	5 17	4 38	4 4	3 39	3 17	2 42	2 18	1 59	1 46	1 35	1 26	1 20	1 14	1 10	1 7
48	7 38	6 26	5 31	4 48	4 13	3 47	3 24	2 47	2 22	2 3	1 49	1 37	1 28	1 21	1 15	1 11	1 8
50			5 42	4 57	4 22	3 54	3 30	2 53	2 26	2 7	1 52	1 40	1 31	1 23	1 16	1 11	1 8
52					4 31	4 1	3 36	2 57	2 30	2 10	1 55	1 42	1 33	1 25	1 18	1 12	1 9
54							3 42	3 2	2 34	2 14	1 57	1 45	1 35	1 26	1 19	1 13	1 10
56								3 7	2 38	2 17	1 59	1 47	1 37	1 27	1 20	1 14	1 10
58									2 42	2 19	2 2	1 49	1 38	1 29	1 21	1 15	1 11
60										2 21	2 3	1 50	1 39	1 30	1 22	1 16	1 11
62											2 5	1 51	1 40	1 31	1 23	1 17	1 12
64												1 52	1 41	1 32	1 24	1 17	1 12
66													1 42	1 32	1 25	1 18	1 13
68														1 32	1 25	1 18	1 13
70															1 25	1 19	1 14
72																1 19	1 14
74																	1 14
76																	
78																	
80																	
82																	
84																	
86																	

TABLE 36.

Apparent Distance, 42°

Apparent Altitude of the Sun or Star.

34°	36°	38°	40°	42°	44°	46°	50°	54°	58°	62°	66°	70°	74°	78°	82°	86°	☾'s Alt.
′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	
5 29	5 50	6 9	6 27	6 46	7 3	7 21											6°
4 37	4 54	5 10	5 21	5 32	5 51	6 10											7
3 59	4 12	4 27	4 40	4 53	5 5	5 18	5 42										8
3 29	3 40	3 52	4 4	4 16	4 26	4 37	4 58										9
3 2	3 12	3 25	3 34	3 44	3 53	4 3	4 22										10
2 39	2 49	3 2	3 12	3 21	3 29	3 37	3 53										11
2 28	2 37	2 46	2 54	3 2	3 9	3 16	3 29	3 42									12
2 15	2 23	2 30	2 37	2 45	2 51	2 58	3 11	3 22									13
2 4	2 10	2 17	2 23	2 30	2 36	2 42	2 54	3 3									14
1 54	2 0	2 6	2 12	2 18	2 23	2 29	2 39	2 47									15
1 46	1 51	1 57	2 2	2 7	2 12	2 17	2 26	2 34	2 41								16
1 39	1 44	1 49	1 53	1 58	2 2	2 7	2 15	2 22	2 29								17
1 33	1 37	1 42	1 47	1 51	1 55	1 59	2 6	2 12	2 18								18
1 28	1 32	1 36	1 40	1 44	1 48	1 52	1 59	2 4	2 9								19
1 25	1 28	1 31	1 35	1 38	1 41	1 45	1 51	1 56	2 1	2 6							20
1 21	1 24	1 27	1 30	1 33	1 36	1 39	1 45	1 50	1 54	1 58							21
1 18	1 20	1 23	1 26	1 29	1 32	1 34	1 39	1 44	1 48	1 51							22
1 15	1 17	1 20	1 22	1 25	1 27	1 30	1 34	1 39	1 43	1 46							23
1 13	1 15	1 17	1 19	1 22	1 24	1 26	1 30	1 34	1 38	1 41	1 44						24
1 12	1 13	1 15	1 17	1 19	1 20	1 22	1 26	1 30	1 33	1 36	1 38						25
1 11	1 12	1 13	1 14	1 16	1 17	1 19	1 22	1 26	1 29	1 31	1 33						26
1 10	1 10	1 11	1 13	1 14	1 15	1 16	1 19	1 22	1 25	1 27	1 28						27
1 9	1 9	1 10	1 11	1 12	1 13	1 14	1 17	1 19	1 21	1 23	1 24	1 25					28
1 8	1 8	1 9	1 9	1 11	1 11	1 12	1 14	1 16	1 17	1 19	1 20	1 21					29
1 7	1 7	1 8	1 8	1 9	1 9	1 10	1 12	1 13	1 14	1 16	1 17	1 18					30
1 6	1 6	1 7	1 7	1 8	1 8	1 8	1 10	1 11	1 12	1 14	1 15	1 16					31
1 6	1 6	1 6	1 6	1 7	1 7	1 7	1 8	1 9	1 10	1 11	1 12	1 13	1 14				32
1 5	1 5	1 5	1 5	1 6	1 6	1 6	1 7	1 7	1 8	1 9	1 10	1 11	1 11				33
1 4	1 4	1 4	1 4	1 5	1 5	1 5	1 6	1 6	1 7	1 8	1 8	1 9	1 9				34
4	1 4	1 4	1 4	1 4	1 4	1 4	1 5	1 5	1 5	1 6	1 6	1 7	1 7				35
4	1 3	1 3	1 3	1 3	1 3	1 3	1 4	1 4	1 4	1 5	1 5	1 5	1 5	1 6			36
4	1 3	1 2	1 2	1 2	1 2	1 2	1 3	1 2	1 2	1 3	1 3	1 3	1 3	1 4			37
4	1 2	1 1	1 1	1 1	1 1	1 1	1 2	1 1	1 1	1 1	1 1	1 2	1 2	1 2			38
4	1 2	1 1	1 1	1 0	1 0	1 0	1 1	1 0	1 0	1 0	1 0	1 1	1 1	1 1			39
4	1 2	1 1	1 1	1 0	1 0	1 0	1 0	0 59	0 59	0 59	0 59	0 59	0 59	0 59	0 59		40
5	1 3	1 1	1 1	1 0	1 0	0 59	0 59	0 58	0 58	0 58	0 58	0 58	0 58	0 58	0 58		41
5	1 3	1 1	1 0	0 59	0 59	0 58	0 58	0 57	0 57	0 57	0 57	0 57	0 57	0 57	0 57		42
5	1 3	1 1	1 0	0 59	0 59	0 58	0 57	0 56	0 56	0 56	0 56	0 56	0 56	0 56	0 56		43
5	1 3	1 1	1 0	0 59	0 58	0 57	0 56	0 55	0 55	0 55	0 55	0 55	0 55	0 55	0 55	0 55	44
5	1 3	1 1	1 0	0 59	0 58	0 57	0 55	0 54	0 54	0 54	0 53	0 53	0 53	0 53	0 53	0 53	46
6	1 3	1 1	1 0	0 59	0 58	0 56	0 54	0 53	0 53	0 52	0 52	0 52	0 51	0 51	0 51	0 51	48
6	1 3	1 1	0 59	0 58	0 57	0 55	0 53	0 52	0 52	0 51	0 51	0 50	0 50	0 50	0 50	0 50	50
6	1 3	1 1	0 59	0 58	0 57	0 55	0 53	0 51	0 51	0 50	0 50	0 49	0 49	0 48	0 48	0 48	52
6	1 3	1 1	0 59	0 58	0 57	0 55	0 52	0 51	0 50	0 49	0 49	0 48	0 48	0 47	0 47		54
7	1 4	1 1	0 59	0 57	0 56	0 54	0 52	0 50	0 49	0 48	0 48	0 47	0 47	0 46	0 46		56
7	1 4	1 1	0 59	0 57	0 55	0 54	0 51	0 49	0 48	0 47	0 47	0 46	0 46	0 45			58
8	1 5	1 2	1 0	0 57	0 55	0 54	0 51	0 49	0 48	0 47	0 46	0 45	0 45	0 44			60
8	1 5	1 2	1 0	0 57	0 55	0 54	0 51	0 49	0 47	0 46	0 45	0 45	0 44				62
8	1 5	1 2	1 0	0 57	0 55	0 54	0 51	0 49	0 47	0 46	0 45	0 44	0 43				64
8	1 5	1 2	1 0	0 57	0 55	0 54	0 51	0 49	0 47	0 45	0 44	0 44					66
9	1 5	1 2	1 0	0 57	0 55	0 54	0 51	0 49	0 47	0 45	0 44	0 43					68
9	1 5	1 2	1 0	0 57	0 55	0 53	0 50	0 48	0 46	0 45	0 44						70
10	1 6	1 2	1 0	0 57	0 55	0 53	0 50	0 48	0 46	0 44	0 43						72
10	1 6	1 2	1 0	0 57	0 55	0 53	0 50	0 48	0 46	0 44							74
10	1 6	1 3	1 1	0 57	0 55	0 53	0 50	0 47	0 45	0 44							76
	1 6	1 3	1 1	0 57	0 54	0 53	0 50	0 47	0 45								78
		1 3	1 1	0 57	0 54	0 53	0 50	0 47	0 45								80
			1 1	0 57	0 54	0 53	0 50	0 47									82
				0 57	0 54	0 53	0 50	0 47									84
					0 54	0 53	0 50										86

TABLE 36.

Apparent Distance, 46°

Apparent Altitude of the Sun or Star.

☽'s Alt.	6°	7°	8°	9°	10°	11°	12°	14°	16°	18°	20°	22°	24°	26°	28°	30°	32°	
	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	
6°	1 16	1 17	1 20	1 24	1 30	1 36	1 44	2 2	2 21	2 41	3 1	3 20	3 40	3 59	4 19	4 37	4 56	
7	1 19	1 16	1 17	1 19	1 23	1 28	1 33	1 46	2 1	2 16	2 33	2 49	3 5	3 21	3 38	3 54	4 10	
8	1 24	1 19	1 16	1 17	1 19	1 22	1 26	1 35	1 47	1 59	2 13	2 27	2 41	2 55	3 9	3 24	3 37	
9	1 30	1 23	1 18	1 16	1 17	1 19	1 21	1 28	1 37	1 47	1 38	2 10	2 22	2 34	2 46	2 57	3 9	
10	1 38	1 27	1 21	1 18	1 16	1 17	1 18	1 23	1 30	1 38	1 47	1 57	2 7	2 17	2 27	2 37	2 48	
11	1 46	1 33	1 25	1 21	1 18	1 16	1 17	1 20	1 25	1 32	1 39	1 47	1 55	2 4	2 13	2 23	2 32	11
12	1 55	1 40	1 30	1 24	1 20	1 17	1 16	1 18	1 21	1 26	1 33	1 39	1 47	1 54	2 2	2 10	2 18	12
13	2 5	1 47	1 36	1 28	1 23	1 19	1 17	1 16	1 18	1 22	1 27	1 33	1 39	1 46	1 53	2 0	2 6	13
14	2 14	1 55	1 42	1 32	1 26	1 21	1 18	1 15	1 16	1 19	1 23	1 28	1 33	1 39	1 45	1 50	1 56	14
15	2 24	2 2	1 48	1 37	1 30	1 24	1 20	1 16	1 15	1 17	1 20	1 24	1 28	1 33	1 38	1 43	1 48	15
16	2 34	2 10	1 54	1 42	1 34	1 27	1 22	1 18	1 15	1 16	1 18	1 20	1 24	1 28	1 32	1 37	1 41	16
17	2 44	2 18	2 1	1 47	1 38	1 31	1 25	1 20	1 16	1 16	1 17	1 18	1 21	1 24	1 27	1 31	1 35	17
18	2 54	2 26	2 8	1 52	1 42	1 35	1 28	1 21	1 17	1 15	1 16	1 17	1 19	1 21	1 23	1 26	1 30	18
19	3 4	2 34	2 15	1 58	1 46	1 39	1 31	1 23	1 18	1 15	1 15	1 16	1 17	1 18	1 20	1 23	1 26	19
20	3 13	2 42	2 22	2 4	1 51	1 43	1 35	1 26	1 20	1 16	1 14	1 15	1 15	1 16	1 18	1 20	1 23	20
21	3 23	2 51	2 29	2 10	1 56	1 47	1 38	1 28	1 22	1 18	1 15	1 13	1 14	1 15	1 16	1 18	1 20	21
22	3 33	2 59	2 36	2 16	2 2	1 52	1 42	1 31	1 24	1 19	1 15	1 12	1 13	1 14	1 15	1 17	1 13	22
23	3 43	3 7	2 43	2 22	2 7	1 56	1 46	1 34	1 26	1 20	1 15	1 13	1 21	1 13	1 14	1 15	1 16	23
24	3 53	3 15	2 50	2 28	2 13	2 0	1 50	1 37	1 27	1 21	1 16	1 13	1 11	1 11	1 12	1 14	1 15	24
25	4 3	3 23	2 57	2 34	2 18	2 5	1 54	1 40	1 29	1 22	1 16	1 14	1 11	1 10	1 11	1 12	1 13	25
26	4 12	3 31	3 4	2 40	2 23	2 9	1 58	1 42	1 31	1 23	1 17	1 14	1 11	1 9	1 10	1 10	1 11	26
27	4 22	3 39	3 11	2 46	2 29	2 14	2 2	1 44	1 33	1 24	1 17	1 15	1 12	1 10	1 9	1 9	1 10	27
28	4 31	3 47	3 18	2 52	2 34	2 19	2 6	1 47	1 35	1 26	1 18	1 16	1 13	1 10	1 8	1 8	1 9	28
29	4 39	3 56	3 26	2 58	2 39	2 23	2 8	1 50	1 37	1 28	1 20	1 16	1 13	1 10	1 8	1 7	1 8	29
30	4 47	4 3	3 32	3 4	2 44	2 28	2 11	1 53	1 39	1 29	1 20	1 17	1 14	1 10	1 8	1 6	1 7	30
31	4 58	4 11	3 38	3 10	2 49	2 32	2 14	1 56	1 41	1 31	1 22	1 18	1 14	1 11	1 9	1 7	1 7	31
32	5 8	4 19	3 45	3 16	2 54	2 36	2 19	1 59	1 43	1 32	1 24	1 19	1 15	1 11	1 9	1 7	1 6	32
33	5 17	4 27	3 51	3 22	2 59	2 41	2 23	2 2	1 45	1 34	1 25	1 20	1 16	1 12	1 10	1 8	1 6	33
34	5 26	4 34	3 58	3 27	3 4	2 45	2 28	2 5	1 48	1 36	1 27	1 21	1 16	1 12	1 10	1 8	1 6	34
35	5 35	4 42	4 4	3 33	3 9	2 50	2 32	2 8	1 51	1 38	1 28	1 22	1 17	1 13	1 10	1 8	1 6	35
36	5 43	4 49	4 11	3 39	3 13	2 54	2 37	2 12	1 54	1 40	1 29	1 23	1 18	1 14	1 11	1 8	1 6	36
37	5 52	4 56	4 17	3 44	3 18	2 58	2 41	2 16	1 56	1 42	1 31	1 24	1 18	1 14	1 11	1 9	1 7	37
38	6 0	5 3	4 23	3 49	3 23	3 2	2 45	2 19	1 59	1 44	1 33	1 25	1 19	1 15	1 12	1 9	1 7	38
39	6 9	5 11	4 29	3 55	3 27	3 6	2 49	2 22	2 2	1 46	1 34	1 26	1 20	1 15	1 12	1 9	1 7	39
40	6 17	5 18	4 35	4 0	3 31	3 11	2 52	2 25	2 4	1 47	1 36	1 27	1 21	1 16	1 13	1 10	1 7	40
41	6 26	5 25	4 41	4 5	3 36	3 15	2 56	2 28	2 7	1 49	1 38	1 29	1 22	1 17	1 14	1 11	1 8	41
42	6 34	5 31	4 47	4 10	3 41	3 19	2 59	2 31	2 9	1 51	1 40	1 31	1 24	1 18	1 14	1 11	1 8	42
43	6 42	5 38	4 53	4 15	3 45	3 23	3 3	2 33	2 11	1 53	1 41	1 32	1 25	1 19	1 15	1 11	1 9	43
44	6 49	5 45	5 0	4 20	3 49	3 27	3 6	2 36	2 13	1 55	1 43	1 34	1 26	1 20	1 15	1 12	1 9	44
46	7 3	5 57	5 9	4 30	3 58	3 35	3 13	2 41	2 18	1 59	1 46	1 36	1 28	1 21	1 16	1 12	1 9	46
48	7 17	6 9	5 20	4 40	4 6	3 42	3 19	2 46	2 22	2 3	1 49	1 38	1 29	1 22	1 17	1 13	1 10	48
50	7 30	6 21	5 30	4 49	4 15	3 48	3 25	2 51	2 26	2 7	1 53	1 41	1 32	1 24	1 18	1 13	1 10	50
52	7 43	6 32	5 39	4 57	4 23	3 55	3 31	2 56	2 30	2 11	1 56	1 44	1 34	1 26	1 20	1 14	1 11	52
54			5 49	5 5	4 30	4 1	3 37	3 1	2 34	2 15	1 59	1 46	1 36	1 27	1 21	1 16	1 12	54
56					4 38	4 7	3 43	3 6	2 38	2 18	2 2	1 49	1 38	1 29	1 22	1 17	1 12	56
58							3 48	3 10	2 42	2 21	2 4	1 51	1 40	1 30	1 23	1 18	1 13	58
60								3 13	2 45	2 23	2 6	1 53	1 41	1 31	1 24	1 18	1 13	60
62									2 47	2 25	2 7	1 54	1 43	1 32	1 25	1 19	1 14	62
64										2 27	2 8	1 55	1 44	1 33	1 26	1 20	1 15	64
66											2 9	1 56	1 45	1 34	1 27	1 21	1 16	66
68												1 57	1 46	1 35	1 28	1 22	1 16	68
70													1 46	1 36	1 29	1 22	1 17	70
72														1 37	1 30	1 23	1 17	72
74															1 31	1 23	1 18	74
76																1 24	1 18	76
78																	1 19	78
80																		80
82																		82
84																		84
86																		86

TABLE 36.

APPARENT DISTANCE, 46°

Apparent Altitude of the Sun or Star.

34°	36°	38°	40°	42°	44°	46°	50°	54°	58°	62°	66°	70°	74°	78°	82°	86°	☾'s Alt.
′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	
5 16	5 34	5 52	6 9	6 27	6 42	6 59	7 29										6°
4 26	4 41	4 56	5 11	5 26	5 39	5 53	6 20										7
3 50	4 3	4 17	4 29	4 42	4 54	5 6	5 28	5 50									8
3 21	3 32	3 44	3 55	4 6	4 16	4 27	4 47	5 5									9
2 58	3 8	3 18	3 27	3 37	3 47	3 56	4 14	4 30									10
2 41	2 50	2 58	3 6	3 15	3 22	3 31	3 46	4 0									11
2 26	2 34	2 42	2 49	2 57	3 4	3 11	3 24	3 36	3 48								12
2 13	2 20	2 28	2 34	2 41	2 47	2 54	3 6	3 17	3 27								13
2 3	2 10	2 16	2 22	2 28	2 33	2 39	2 51	3 0	3 9								14
1 54	2 0	2 6	2 11	2 16	2 21	2 27	2 36	2 45	2 53								15
1 46	1 51	1 56	2 0	2 7	2 11	2 16	2 24	2 33	2 40	2 46							16
1 39	1 44	1 49	1 54	1 59	2 2	2 6	2 14	2 22	2 29	2 34							17
1 34	1 38	1 43	1 47	1 51	1 55	1 59	2 6	2 13	2 19	2 24							18
1 29	1 33	1 37	1 41	1 45	1 48	1 52	1 58	2 4	2 10	2 15							19
1 26	1 29	1 32	1 35	1 39	1 42	1 45	1 51	1 57	2 2	2 7	2 11						20
1 23	1 26	1 28	1 31	1 34	1 37	1 40	1 45	1 51	1 56	2 0	2 3						21
1 20	1 23	1 25	1 27	1 30	1 32	1 35	1 40	1 45	1 50	1 54	1 56						22
1 18	1 20	1 22	1 24	1 26	1 28	1 31	1 36	1 40	1 45	1 48	1 50						23
1 16	1 17	1 19	1 21	1 23	1 25	1 27	1 32	1 36	1 40	1 43	1 45	1 47					24
1 14	1 15	1 17	1 18	1 20	1 22	1 23	1 27	1 31	1 35	1 38	1 40	1 41					25
1 12	1 13	1 15	1 16	1 17	1 19	1 21	1 24	1 27	1 31	1 33	1 35	1 36					26
1 11	1 12	1 13	1 14	1 15	1 16	1 18	1 21	1 24	1 27	1 29	1 31	1 32					27
1 10	1 11	1 12	1 12	1 13	1 14	1 16	1 18	1 21	1 23	1 25	1 27	1 28	1 30				28
1 9	1 9	1 10	1 11	1 12	1 13	1 14	1 16	1 18	1 20	1 22	1 23	1 25	1 26				29
1 8	1 8	1 9	1 10	1 10	1 11	1 12	1 14	1 16	1 17	1 19	1 20	1 22	1 23				30
1 7	1 7	1 8	1 9	1 9	1 10	1 10	1 12	1 14	1 15	1 17	1 18	1 19	1 20				31
1 7	1 7	1 7	1 8	1 8	1 9	1 9	1 10	1 12	1 13	1 15	1 16	1 17	1 17	1 18			32
1 6	1 6	1 6	1 7	1 7	1 8	1 8	1 9	1 10	1 11	1 12	1 13	1 14	1 15	1 15			33
1 5	1 5	1 5	1 6	1 6	1 7	1 7	1 8	1 8	1 9	1 10	1 11	1 12	1 13	1 13			34
1 5	1 5	1 5	1 5	1 5	1 6	1 6	1 7	1 7	1 7	1 8	1 9	1 10	1 11	1 11			35
1 5	1 4	1 4	1 4	1 4	1 4	1 4	1 5	1 5	1 6	1 7	1 7	1 8	1 9	1 9	1 10		36
1 5	1 4	1 3	1 3	1 3	1 3	1 3	1 4	1 4	1 5	1 5	1 6	1 6	1 7	1 7	1 8		37
1 5	1 3	1 2	1 2	1 2	1 2	1 2	1 3	1 3	1 4	1 4	1 5	1 5	1 6	1 6	1 6		38
1 5	1 3	1 2	1 2	1 1	1 1	1 1	1 2	1 2	1 3	1 3	1 4	1 4	1 4	1 5	1 5		39
1 5	1 3	1 2	1 2	1 1	1 1	1 1	1 2	1 2	1 2	1 2	1 3	1 3	1 3	1 3	1 4	1 4	40
1 6	1 4	1 2	1 2	1 1	1 1	1 1	1 1	1 1	1 1	1 1	1 2	1 2	1 2	1 2	1 3	1 3	41
1 6	1 4	1 2	1 1	1 0	1 0	1 0	1 0	1 0	1 0	1 0	1 1	1 0	1 1	1 1	1 1	1 1	42
1 6	1 4	1 3	1 1	1 0	1 0	1 0	0 59	0 59	0 59	0 59	1 0	1 0	1 0	1 0	1 0	1 0	43
1 7	1 4	1 3	1 1	1 0	1 0	0 59	0 58	0 58	0 58	0 58	0 59	0 59	0 59	0 59	0 59	0 59	44
1 7	1 4	1 3	1 1	1 0	0 59	0 59	0 57	0 57	0 57	0 57	0 57	0 57	0 57	0 57	0 57	0 57	46
1 8	1 5	1 3	1 2	1 0	0 59	0 58	0 57	0 56	0 56	0 56	0 55	0 55	0 55	0 55	0 55	0 55	48
1 8	1 5	1 3	1 2	1 0	0 59	0 58	0 56	0 55	0 55	0 55	0 54	0 54	0 54	0 54	0 54		50
1 8	1 6	1 3	1 2	1 0	0 59	0 57	0 55	0 54	0 54	0 54	0 53	0 53	0 52	0 52	0 52		52
1 9	1 6	1 4	1 2	1 0	0 58	0 57	0 55	0 54	0 53	0 53	0 52	0 52	0 51	0 51			54
1 9	1 6	1 4	1 2	1 0	0 58	0 57	0 55	0 53	0 52	0 52	0 51	0 51	0 50	0 50			56
1 10	1 7	1 4	1 2	1 0	0 58	0 57	0 55	0 53	0 52	0 51	0 50	0 50	0 49				58
1 10	1 7	1 4	1 2	1 0	0 58	0 57	0 55	0 53	0 51	0 50	0 50	0 49	0 48				60
1 11	1 8	1 5	1 3	1 0	0 58	0 57	0 55	0 53	0 51	0 50	0 49	0 49					62
1 11	1 8	1 5	1 3	1 0	0 58	0 57	0 55	0 53	0 51	0 50	0 49	0 48					64
1 12	1 8	1 5	1 3	1 1	0 59	0 57	0 55	0 52	0 50	0 49	0 48						66
1 12	1 8	1 5	1 3	1 1	0 59	0 57	0 54	0 52	0 50	0 49	0 48						68
1 13	1 9	1 6	1 3	1 1	0 59	0 57	0 54	0 52	0 50	0 49							70
1 13	1 9	1 6	1 4	1 1	0 59	0 57	0 54	0 52	0 50	0 48							72
1 13	1 9	1 6	1 4	1 1	0 59	0 57	0 54	0 51	0 49								74
1 14	1 10	1 6	1 4	1 1	0 59	0 57	0 54	0 51	0 49								76
1 14	1 10	1 7	1 5	1 1	0 59	0 57	0 54	0 51									78
1 14	1 10	1 7	1 5	1 1	0 59	0 57	0 54	0 51									80
	1 10	1 7	1 5	1 1	0 59	0 57	0 54										82
		1 7	1 5	1 1	0 59	0 57	0 54										84
			1 5	1 1	0 59	0 57											86
34°	36°	38°	40°	42°	44°	46°	50°	54°	58°	62°	66°	70°	74°	78°	82°	86°	

TABLE 36.

Apparent Distance, 50°

Apparent Altitude of the Sun or Star.

☽'s Alt.	6°	7°	8°	9°	10°	11°	12°	14°	16°	18°	20°	22°	24°	26°	28°	30°	32°	☾'s Alt.
	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	
6°	1 21	1 13	1 16	1 19	1 25	1 32	1 40	1 57	2 7	2 32	2 50	3 9	3 28	3 47	4 6	4 25	4 45	6°
7	1 25	1 14	1 15	1 16	1 20	1 26	1 32	1 46	2 1	2 16	2 33	2 48	3 3	3 20	3 36	3 53	4 9	7
8	1 29	1 15	1 14	1 14	1 15	1 19	1 23	1 35	1 44	1 56	2 7	2 20	2 34	2 48	3 1	3 14	3 27	8
9	1 36	1 21	1 17	1 13	1 14	1 16	1 18	1 26	1 35	1 47	1 58	2 9	2 21	2 33	2 44	2 55	3 6	9
10	1 43	1 25	1 23	1 17	1 13	1 15	1 17	1 22	1 27	1 35	1 44	1 53	2 2	2 12	2 22	2 33	2 42	10
11	1 51	1 32	1 25	1 20	1 16	1 14	1 16	1 19	1 24	1 31	1 38	1 47	1 55	2 3	2 12	2 21	2 29	11
12	1 59	1 38	1 30	1 24	1 19	1 17	1 15	1 18	1 20	1 23	1 30	1 37	1 44	1 50	1 57	2 4	2 12	12
13	2 8	1 46	1 36	1 27	1 22	1 19	1 17	1 15	1 16	1 20	1 25	1 32	1 37	1 44	1 51	1 58	2 4	13
14	2 17	1 54	1 42	1 33	1 25	1 22	1 19	1 15	1 14	1 17	1 22	1 27	1 32	1 38	1 43	1 50	1 57	14
15	2 26	2 1	1 47	1 38	1 28	1 24	1 20	1 16	1 14	1 14	1 17	1 22	1 27	1 32	1 37	1 42	1 48	15
16	2 36	2 8	1 52	1 44	1 31	1 26	1 22	1 15	1 12	1 12	1 14	1 17	1 20	1 25	1 29	1 34	1 38	16
17	2 45	2 16	1 59	1 50	1 34	1 29	1 24	1 17	1 14	1 13	1 13	1 16	1 18	1 22	1 25	1 30	1 35	17
18	2 54	2 24	2 6	1 56	1 38	1 33	1 27	1 19	1 15	1 13	1 13	1 15	1 16	1 20	1 23	1 27	1 30	18
19	3 3	2 31	2 12	2 0	1 43	1 37	1 31	1 22	1 16	1 13	1 12	1 13	1 14	1 17	1 18	1 22	1 25	19
20	3 13	2 38	2 19	2 4	1 49	1 42	1 35	1 24	1 18	1 14	1 12	1 12	1 11	1 14	1 15	1 19	1 21	20
21	3 22	2 47	2 27	2 9	1 55	1 46	1 38	1 27	1 19	1 15	1 12	1 11	1 10	1 13	1 14	1 17	1 19	21
22	3 31	2 56	2 34	2 14	2 0	1 50	1 41	1 29	1 20	1 15	1 12	1 10	1 9	1 11	1 12	1 14	1 16	22
23	3 40	3 3	2 41	2 19	2 6	1 55	1 44	1 31	1 22	1 16	1 12	1 9	1 9	1 10	1 12	1 12	1 15	23
24	3 50	3 12	2 48	2 24	2 12	1 59	1 47	1 34	1 24	1 17	1 13	1 9	1 9	1 10	1 11	1 12	1 13	24
25	3 59	3 21	2 56	2 31	2 17	2 5	1 50	1 37	1 26	1 19	1 14	1 10	1 9	1 9	1 10	1 11	1 11	25
26	4 9	3 30	3 4	2 37	2 22	2 10	1 54	1 40	1 29	1 21	1 15	1 11	1 9	1 9	1 10	1 10	1 11	26
27	4 18	3 38	3 11	2 43	2 27	2 14	1 58	1 43	1 31	1 23	1 16	1 11	1 9	1 9	1 9	1 9	1 10	27
28	4 27	3 45	3 19	2 50	2 31	2 18	2 2	1 45	1 33	1 24	1 17	1 12	1 9	1 9	1 9	1 8	1 9	28
29	4 35	3 52	3 27	2 57	2 35	2 22	2 7	1 47	1 35	1 25	1 18	1 13	1 9	1 8	1 9	1 7	1 8	29
30	4 44	4 0	3 33	3 3	2 40	2 26	2 12	1 50	1 37	1 27	1 19	1 14	1 10	1 8	1 8	1 7	1 7	30
31	4 53	4 7	3 39	3 8	2 45	2 31	2 16	1 53	1 39	1 29	1 20	1 15	1 11	1 9	1 8	1 6	1 6	31
32	5 2	4 14	3 45	3 13	2 50	2 35	2 20	1 57	1 42	1 31	1 22	1 17	1 12	1 9	1 7	1 6	1 5	32
33	5 11	4 21	3 50	3 18	2 55	2 39	2 24	2 0	1 44	1 33	1 24	1 18	1 13	1 10	1 7	1 6	1 5	33
34	5 19	4 29	3 55	3 24	3 0	2 43	2 28	2 3	1 46	1 35	1 26	1 19	1 14	1 11	1 8	1 7	1 5	34
35	5 29	4 38	4 0	3 30	3 6	2 48	2 33	2 6	1 49	1 38	1 28	1 20	1 15	1 12	1 9	1 7	1 6	35
36	5 38	4 47	4 6	3 36	3 11	2 52	2 37	2 10	1 52	1 40	1 30	1 21	1 16	1 13	1 10	1 8	1 7	36
37	5 46	4 55	4 11	3 41	3 16	2 57	2 40	2 13	1 54	1 41	1 31	1 23	1 17	1 14	1 11	1 9	1 8	37
38	5 55	5 2	4 17	3 47	3 22	3 2	2 44	2 16	1 57	1 44	1 33	1 24	1 18	1 15	1 11	1 10	1 9	38
39	6 3	5 8	4 22	3 52	3 27	3 7	2 48	2 20	2 0	1 47	1 35	1 26	1 20	1 16	1 12	1 11	1 9	39
40	6 12	5 14	4 27	3 57	3 32	3 11	2 53	2 24	2 3	1 50	1 38	1 29	1 22	1 17	1 13	1 12	1 10	40
41	6 19	5 19	4 32	4 3	3 37	3 14	2 55	2 28	2 6	1 52	1 40	1 30	1 23	1 18	1 14	1 13	1 10	41
42	6 27	5 24	4 37	4 9	3 42	3 17	2 58	2 32	2 8	1 54	1 42	1 32	1 25	1 19	1 15	1 14	1 11	42
43	6 33	5 30	4 42	4 14	3 47	3 20	3 1	2 36	2 11	1 56	1 43	1 33	1 26	1 20	1 16	1 15	1 12	43
44	6 41	5 36	4 51	4 19	3 52	3 26	3 4	2 20	2 14	1 58	1 45	1 36	1 27	1 21	1 17	1 16	1 12	44
46	6 56	5 46	5 1	4 27	3 58	3 32	3 10	2 44	2 17	2 1	1 48	1 38	1 29	1 22	1 18	1 16	1 13	46
48	7 11	5 57	5 10	4 35	4 5	3 38	3 16	2 48	2 21	2 4	1 50	1 39	1 30	1 24	1 19	1 17	1 14	48
50	7 24	6 9	5 20	4 44	4 13	3 45	3 22	2 52	2 25	2 7	1 53	1 41	1 32	1 26	1 20	1 18	1 14	50
52	7 36	6 19	5 29	4 52	4 21	3 52	3 28	2 55	2 28	2 10	1 55	1 43	1 33	1 27	1 21	1 19	1 15	52
54	7 48	6 30	5 38	5 1	4 28	3 59	3 33	2 58	2 32	2 13	1 58	1 45	1 35	1 29	1 22	1 19	1 16	54
56	8 0	6 42	5 47	5 10	4 35	4 6	3 38	3 1	2 36	2 15	2 0	1 48	1 38	1 32	1 23	1 20	1 17	56
58			5 56	5 19	4 42	4 13	3 43	3 4	2 41	2 19	2 4	1 51	1 41	1 35	1 24	1 21	1 18	58
60					4 49	4 20	3 48	3 8	2 44	2 22	2 6	1 53	1 43	1 36	1 25	1 22	1 18	60
62							3 53	3 12	2 47	2 25	2 7	1 54	1 45	1 37	1 26	1 23	1 19	62
64								3 16	2 50	2 27	2 8	1 55	1 46	1 38	1 27	1 24	1 19	64
66									2 51	2 29	2 10	1 56	1 46	1 39	1 28	1 25	1 20	66
68										2 31	2 13	1 58	1 47	1 40	1 29	1 26	1 21	68
70											2 15	2 0	1 47	1 40	1 30	1 27	1 22	70
72												2 3	1 51	1 41	1 31	1 28	1 23	72
74													1 51	1 41	1 32	1 29	1 23	74
76														1 42	1 33	1 30	1 24	76
78															1 34	1 30	1 24	78
80																1 30	1 24	80
82																	1 25	82
84																		84
86																		86
	6°	7°	8°	9°	10°	11°	12°	14°	16°	18°	20°	22°	24°	26°	28°	30°	32°	

TABLE 36.

APPARENT DISTANCE, 50°

Apparent Altitude of the Sun or Star.

34°	36°	38°	40°	42°	44°	46°	50°	54°	58°	62°	66°	70°	74°	78°	82°	86°	☾'s Alt
′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	
5 2	5 18	5 33	5 49	6 7	6 24	6 40	7 8	7 34									6°
4 24	4 39	4 53	5 6	5 17	5 31	5 44	6 16	6 34									7
3 41	3 54	4 5	4 17	4 29	4 42	4 53	5 15	5 37	5 57								8
3 19	3 30	3 40	3 49	3 55	4 8	4 21	4 36	5 1	5 15								9
2 51	3 2	3 11	3 22	3 29	3 39	3 50	4 5	4 22	4 32								10
2 37	2 46	2 56	3 5	3 11	3 20	3 28	3 36	3 59	4 10								11
2 20	2 29	2 36	2 44	2 50	2 59	3 5	3 19	3 32	3 42	3 52							12
2 11	2 18	2 25	2 30	2 37	2 44	2 50	3 3	3 15	3 24	3 33							13
2 4	2 9	2 14	2 19	2 26	2 32	2 36	2 47	2 59	3 9	3 17							14
1 53	1 58	2 3	2 8	2 13	2 19	2 23	2 33	2 43	2 51	2 59							15
1 43	1 48	1 53	1 58	2 3	2 8	2 11	2 20	2 29	2 41	2 45	2 50						16
1 38	1 43	1 46	1 51	1 55	2 0	2 3	2 11	2 20	2 27	2 34	2 40						17
1 34	1 38	1 41	1 45	1 49	1 53	1 56	2 4	2 12	2 19	2 25	2 29						18
1 29	1 31	1 34	1 37	1 41	1 46	1 48	1 55	2 4	2 9	2 15	2 19						19
1 25	1 28	1 30	1 33	1 36	1 39	1 42	1 48	1 54	1 58	2 7	2 10	2 14					20
1 22	1 25	1 27	1 30	1 32	1 36	1 38	1 43	1 49	1 53	2 0	2 3	2 6					21
1 19	1 22	1 23	1 27	1 28	1 31	1 33	1 37	1 42	1 46	1 52	1 56	1 58					22
1 18	1 19	1 20	1 22	1 24	1 27	1 29	1 34	1 37	1 40	1 45	1 49	1 51					23
1 14	1 18	1 19	1 21	1 22	1 25	1 26	1 29	1 32	1 36	1 40	1 44	1 47	1 52				24
1 13	1 15	1 17	1 18	1 19	1 21	1 23	1 27	1 29	1 32	1 37	1 40	1 44	1 49				25
1 12	1 13	1 15	1 16	1 17	1 19	1 20	1 24	1 26	1 29	1 33	1 36	1 39	1 43				26
1 10	1 11	1 13	1 14	1 14	1 17	1 18	1 22	1 23	1 25	1 30	1 33	1 36	1 37				27
1 9	1 10	1 10	1 10	1 11	1 13	1 15	1 18	1 21	1 22	1 26	1 28	1 31	1 32	1 33			28
1 8	1 9	1 8	1 9	1 10	1 12	1 12	1 15	1 18	1 20	1 22	1 24	1 27	1 28	1 29			29
1 7	1 8	1 7	1 8	1 9	1 11	1 12	1 13	1 16	1 17	1 19	1 21	1 24	1 25	1 26			30
1 7	1 7	1 6	1 7	1 8	1 9	1 10	1 11	1 14	1 15	1 16	1 18	1 21	1 22	1 23			31
1 5	1 7	1 6	1 6	1 7	1 8	1 8	1 9	1 11	1 13	1 14	1 15	1 17	1 18	1 20	1 20		32
1 5	1 6	1 6	1 6	1 6	1 7	1 7	1 8	1 10	1 12	1 12	1 13	1 15	1 16	1 18	1 19		33
1 5	1 6	1 6	1 6	1 6	1 6	1 6	1 7	1 8	1 11	1 10	1 13	1 13	1 14	1 15	1 17		34
1 6	1 6	1 6	1 6	1 6	1 6	1 6	1 7	1 8	1 10	1 11	1 11	1 12	1 13	1 14	1 15		35
1 6	1 5	1 5	1 5	1 5	1 6	1 6	1 6	1 7	1 8	1 9	1 10	1 11	1 11	1 12	1 12	1 13	36
1 7	1 5	1 5	1 5	1 5	1 5	1 5	1 5	1 6	1 6	1 7	1 8	1 8	1 8	1 8	1 8	1 9	37
1 7	1 6	1 5	1 5	1 4	1 5	1 5	1 5	1 6	1 6	1 6	1 6	1 7	1 7	1 7	1 8	1 8	38
1 8	1 6	1 5	1 5	1 4	1 5	1 5	1 5	1 5	1 5	1 6	1 6	1 7	1 7	1 6	1 6	1 7	39
1 8	1 6	1 5	1 4	1 3	1 5	1 5	1 5	1 5	1 5	1 6	1 6	1 6	1 6	1 6	1 6	1 6	40
8	1 7	1 5	1 4	1 3	1 4	1 4	1 4	1 4	1 3	1 4	1 4	1 5	1 5	1 4	1 4	1 2	41
9	1 7	1 5	1 4	1 3	1 4	1 4	1 4	1 3	1 2	1 2	1 3	1 4	1 4	1 3	1 2	1 1	42
9	1 7	1 5	1 4	1 3	1 4	1 4	1 3	1 2	1 1	1 1	1 2	1 3	1 3	1 2	1 1	1 0	43
10	1 7	1 4	1 4	1 3	1 4	1 4	1 2	1 1	1 0	1 1	1 1	1 2	1 2	1 1	1 0	1 0	44
10	1 7	1 4	1 4	1 3	1 4	1 4	1 1	0 59	0 59	0 59	1 0	1 1	1 1	0 59	0 59		46
10	1 7	1 4	1 4	1 3	1 4	1 4	1 0	0 59	0 59	0 59	0 59	0 59	0 58	0 58	0 58		48
11	1 8	1 4	1 4	1 3	1 4	1 3	0 59	0 59	0 59	0 58	0 58	0 58	0 57	0 57			50
11	1 9	1 5	1 4	1 2	1 4	1 3	0 59	0 59	0 59	0 57	0 57	0 57	0 57	0 57			52
12	1 10	1 5	1 4	1 2	1 4	1 3	0 59	0 59	0 58	0 57	0 56	0 56	0 56				54
13	1 11	1 6	1 5	1 2	1 3	1 2	0 59	0 59	0 58	0 57	0 56	0 56	0 56				56
14	1 12	1 6	1 5	1 2	1 3	1 2	0 59	0 59	0 58	0 57	0 56	0 56					58
15	1 12	1 6	1 5	1 2	1 3	1 2	0 59	0 58	0 58	0 56	0 56	0 55					60
16	1 12	1 6	1 5	1 2	1 3	1 2	0 59	0 58	0 57	0 56	0 55						62
16	1 13	1 7	1 5	1 2	1 3	1 1	0 59	0 57	0 56	0 54	0 54						64
17	1 13	1 7	1 5	1 2	1 3	1 1	0 59	0 57	0 55	0 54							66
17	1 13	1 7	1 6	1 2	1 3	1 1	0 59	0 57	0 55	0 54							68
17	1 13	1 8	1 6	1 2	1 3	1 1	0 59	0 57	0 55								70
18	1 14	1 8	1 7	1 2	1 3	1 1	0 59	0 57	0 55								72
18	1 14	1 9	1 7	1 2	1 3	1 1	0 59	0 57									74
19	1 14	1 9	1 7	1 2	1 3	1 1	0 58	0 57									76
19	1 14	1 10	1 8	1 2	1 3	1 1	0 58										78
19	1 14	1 10	1 8	1 2	1 3	1 0	0 58										80
19	1 14	1 11	1 8	1 2	1 3	1 0											82
19	1 14	1 11	1 8	1 2	1 3	1 0											84
	1 14	1 11	1 9	1 2	1 3												86
4°	36°	38°	40°	42°	44°	46°	50°	54°	58°	62°	66°	70°	74°	78°	82°	86°	

TABLE 36.

APPARENT DISTANCE, 54°

Apparent Altitude of the Sun or Star.

☾'s Alt.	6°	7°	8°	9°	10°	11°	12°	14°	16°	18°	20°	22°	24°	26°	28°	30°	32°	☾'s Alt.
	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	
6°	1 15	1 13	1 23	1 25	1 31	1 37	1 43	1 59	2 14	2 32	2 49	3 7	3 25	3 44	4 2	4 20	4 37	
7	1 19	1 14	1 15	1 18	1 23	1 27	1 32	1 44	1 57	2 10	2 24	2 38	2 52	3 9	3 25	3 41	3 57	
8	1 23	1 19	1 18	1 18	1 20	1 22	1 26	1 34	1 44	1 55	2 7	2 19	2 32	2 46	2 59	3 18	3 25	
9	1 34	1 25	1 19	1 17	1 18	1 20	1 22	1 29	1 37	1 48	1 58	2 8	2 18	2 29	2 40	2 51	3 3	
10	1 41	1 30	1 24	1 20	1 17	1 18	1 19	1 22	1 30	1 38	1 48	1 58	2 1	2 11	2 23	2 30	2 40	
11	1 48	1 36	1 28	1 23	1 19	1 15	1 16	1 20	1 24	1 31	1 38	1 46	1 54	2 2	2 10	2 18	2 27	11
12	1 54	1 42	1 32	1 25	1 20	1 16	1 14	1 17	1 20	1 24	1 29	1 35	1 42	1 50	1 57	2 4	2 12	12
13	2 2	1 48	1 37	1 28	1 22	1 18	1 15	1 16	1 17	1 22	1 26	1 31	1 37	1 44	1 50	1 56	2 2	13
14	2 10	1 55	1 42	1 32	1 25	1 20	1 17	1 16	1 15	1 20	1 23	1 28	1 33	1 38	1 44	1 49	1 55	14
15	2 17	2 2	1 47	1 36	1 29	1 23	1 18	1 17	1 14	1 17	1 18	1 22	1 27	1 32	1 37	1 42	1 48	15
16	2 24	2 8	1 52	1 40	1 31	1 24	1 19	1 18	1 14	1 15	1 16	1 18	1 22	1 27	1 30	1 34	1 39	16
17	2 33	2 14	1 58	1 44	1 35	1 27	1 21	1 18	1 15	1 14	1 15	1 16	1 19	1 24	1 27	1 30	1 34	17
18	2 42	2 21	2 3	1 49	1 40	1 31	1 24	1 19	1 16	1 13	1 14	1 15	1 17	1 21	1 24	1 27	1 31	18
19	2 50	2 27	2 10	1 55	1 44	1 35	1 28	1 20	1 16	1 14	1 13	1 14	1 16	1 19	1 21	1 24	1 28	19
20	2 59	2 35	2 17	2 1	1 49	1 39	1 32	1 22	1 17	1 15	1 11	1 13	1 14	1 16	1 18	1 20	1 23	20
21	3 8	2 43	2 24	2 8	1 55	1 44	1 35	1 25	1 18	1 16	1 13	1 12	1 12	1 15	1 17	1 18	1 20	21
22	3 17	2 50	2 31	2 14	1 59	1 48	1 37	1 27	1 20	1 17	1 14	1 13	1 12	1 12	1 13	1 15	1 17	22
23	3 27	2 57	2 37	2 18	2 4	1 51	1 40	1 30	1 23	1 18	1 16	1 14	1 11	1 11	1 12	1 13	1 15	23
24	3 36	3 5	2 42	2 22	2 8	1 54	1 43	1 33	1 24	1 21	1 17	1 14	1 11	1 11	1 11	1 12	1 13	24
25	3 46	3 14	2 48	2 26	2 12	1 58	1 47	1 35	1 26	1 22	1 18	1 14	1 12	1 11	1 11	1 12	1 12	25
26	3 56	3 22	2 54	2 32	2 16	2 2	1 51	1 37	1 28	1 24	1 19	1 15	1 13	1 11	1 11	1 12	1 12	26
27	4 5	3 30	3 1	2 38	2 21	2 6	1 55	1 41	1 31	1 25	1 20	1 16	1 14	1 12	1 11	1 11	1 12	27
28	4 14	3 39	3 9	2 46	2 27	2 10	2 0	1 44	1 34	1 26	1 21	1 17	1 15	1 12	1 11	1 11	1 11	28
29	4 23	3 46	3 16	2 50	2 31	2 14	2 3	1 47	1 37	1 28	1 22	1 18	1 16	1 13	1 12	1 11	1 11	29
30	4 32	3 53	3 21	2 55	2 36	2 19	2 7	1 51	1 39	1 29	1 23	1 19	1 16	1 13	1 12	1 11	1 11	30
31	4 39	3 59	3 26	3 0	2 41	2 24	2 11	1 53	1 42	1 31	1 24	1 20	1 16	1 14	1 12	1 11	1 11	31
32	4 46	4 7	3 31	3 7	2 47	2 29	2 15	1 56	1 44	1 34	1 26	1 21	1 17	1 14	1 13	1 11	1 11	32
33	4 55	4 15	3 37	3 13	2 52	2 34	2 19	1 59	1 46	1 36	1 27	1 22	1 18	1 15	1 13	1 11	1 10	33
34	5 4	4 23	3 44	3 18	2 56	2 39	2 22	2 2	1 48	1 38	1 29	1 23	1 19	1 15	1 13	1 11	1 10	34
35	5 11	4 29	3 51	3 24	3 1	2 44	2 26	2 5	1 50	1 40	1 31	1 24	1 20	1 16	1 13	1 11	1 10	35
36	5 19	4 36	3 59	3 30	3 6	2 47	2 30	2 9	1 53	1 42	1 32	1 26	1 21	1 17	1 14	1 12	1 10	36
37	5 27	4 42	4 5	3 35	3 11	2 51	2 33	2 13	1 55	1 44	1 34	1 27	1 23	1 18	1 14	1 12	1 11	37
38	5 36	4 49	4 11	3 40	3 16	2 54	2 37	2 15	1 57	1 47	1 37	1 29	1 24	1 19	1 15	1 14	1 12	38
39	5 43	4 55	4 17	3 45	3 20	2 58	2 41	2 18	1 59	1 48	1 38	1 31	1 25	1 20	1 16	1 14	1 12	39
40	5 50	5 2	4 23	3 49	3 24	3 2	2 44	2 22	2 1	1 49	1 39	1 32	1 26	1 21	1 17	1 14	1 13	40
41	5 57	5 8	4 29	3 54	3 28	3 6	2 47	2 24	2 2	1 51	1 40	1 33	1 27	1 22	1 18	1 15	1 13	41
42	6 5	5 15	4 35	4 0	3 32	3 10	2 51	2 26	2 5	1 53	1 41	1 34	1 28	1 23	1 18	1 15	1 14	42
43	6 12	5 22	4 40	4 4	3 36	3 14	2 56	2 29	2 9	1 56	1 43	1 35	1 29	1 24	1 19	1 16	1 14	43
44	6 20	5 29	4 46	4 9	3 41	3 18	3 0	2 32	2 13	1 58	1 44	1 36	1 30	1 25	1 19	1 16	1 15	44
46	6 33	5 40	4 55	4 19	3 49	3 24	3 6	2 36	2 16	2 0	1 46	1 37	1 31	1 26	1 20	1 17	1 15	46
48	6 46	5 50	5 4	4 27	3 56	3 31	3 12	2 40	2 20	2 3	1 49	1 39	1 32	1 27	1 20	1 17	1 16	48
50	7 0	6 2	5 13	4 36	4 4	3 37	3 18	2 46	2 23	2 6	1 51	1 41	1 33	1 28	1 21	1 18	1 16	50
52	7 12	6 13	5 21	4 44	4 11	3 45	3 23	2 51	2 26	2 10	1 54	1 43	1 34	1 29	1 23	1 19	1 17	52
54	7 23	6 23	5 30	4 51	4 18	3 53	3 28	2 57	2 29	2 13	1 57	1 46	1 37	1 31	1 25	1 21	1 18	54
56	7 35	6 32	5 38	4 58	4 25	3 59	3 33	3 2	2 34	2 17	2 0	1 49	1 40	1 33	1 27	1 23	1 20	56
58	7 45	6 40	5 46	5 5	4 31	4 5	3 40	3 8	2 39	2 21	2 3	1 52	1 43	1 36	1 29	1 24	1 21	58
60	7 55	6 47	5 53	5 11	4 36	4 10	3 46	3 12	2 44	2 24	2 7	1 55	1 45	1 38	1 30	1 25	1 22	60
62			5 58	5 15	4 41	4 15	3 51	3 16	2 48	2 26	2 10	1 56	1 48	1 40	1 31	1 26	1 23	62
64					4 47	4 21	3 56	3 20	2 51	2 28	2 12	1 58	1 48	1 42	1 32	1 27	1 24	64
66							3 59	3 24	2 52	2 30	2 14	2 0	1 49	1 43	1 33	1 29	1 25	66
68								3 27	2 53	2 33	2 16	2 2	1 50	1 43	1 34	1 29	1 25	68
70									2 54	2 34	2 18	2 3	1 51	1 43	1 35	1 29	1 25	70
72										2 36	2 19	2 4	1 52	1 43	1 35	1 29	1 25	72
74											2 19	2 5	1 53	1 44	1 36	1 29	1 25	74
76												2 6	1 54	1 44	1 36	1 30	1 25	76
78													1 55	1 45	1 37	1 30	1 26	78
80														1 45	1 37	1 31	1 26	80
82															1 38	1 31	1 26	82
84																1 32	1 26	84
86																	1 27	86
	6°	7°	8°	9°	10°	11°	12°	14°	16°	18°	20°	22°	24°	26°	28°	30°	36°	

TABLE 36.

APPARENT DISTANCE, 54°

Apparent Altitude of the Sun or Star.

34°	36°	38°	40°	42°	44°	46°	50°	54°	58°	62°	66°	70°	74°	78°	82°	86°	☾'s Alt.
′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	
4 54	5 12	5 27	5 42	5 58	6 14	6 28	6 55	7 21	7 40								6°
4 13	4 29	4 42	4 54	5 6	5 18	5 30	5 53	6 15	6 42								7
3 38	3 51	4 2	4 12	4 24	4 36	4 46	5 7	5 28	5 44	5 57							8
3 14	3 25	3 35	3 46	3 56	4 6	4 14	4 35	4 51	5 6	5 17							9
2 50	3 0	3 10	3 19	3 27	3 35	3 42	3 58	4 14	4 27	4 40							10
2 35	2 44	2 51	3 0	3 9	3 16	3 22	3 37	3 46	4 2	4 12							11
2 20	2 28	2 34	2 42	2 49	2 57	3 2	3 15	3 27	3 37	3 46	3 56						12
2 9	2 16	2 22	2 29	2 34	2 41	2 47	2 59	3 10	3 19	3 27	3 36						13
2 0	2 6	2 11	2 17	2 22	2 29	2 34	2 45	2 54	3 2	3 10	3 18						14
1 53	1 58	2 2	2 7	2 12	2 18	2 23	2 33	2 41	2 49	2 56	3 3						15
1 44	1 48	1 53	1 59	2 3	2 9	2 13	2 22	2 30	2 37	2 43	2 49	2 54					16
1 40	1 44	1 48	1 53	1 56	2 1	2 4	2 13	2 21	2 28	2 33	2 39	2 44					17
1 35	1 40	1 43	1 47	1 50	1 54	1 57	2 4	2 11	2 18	2 24	2 28	2 33					18
1 31	1 35	1 38	1 42	1 45	1 49	1 51	1 58	2 4	2 10	2 15	2 20	2 24					19
1 26	1 30	1 33	1 35	1 38	1 42	1 45	1 51	1 55	2 0	2 5	2 11	2 16	2 17				20
1 23	1 26	1 28	1 32	1 34	1 36	1 39	1 45	1 51	1 55	2 0	2 4	2 8	2 11				21
1 19	1 22	1 24	1 27	1 29	1 32	1 34	1 40	1 44	1 48	1 52	1 57	2 1	2 3				22
1 17	1 20	1 21	1 24	1 26	1 29	1 30	1 35	1 39	1 43	1 48	1 53	1 55	1 57				23
1 15	1 17	1 19	1 21	1 22	1 25	1 26	1 31	1 34	1 38	1 42	1 46	1 48	1 50	1 53			24
1 13	1 15	1 17	1 20	1 21	1 23	1 24	1 28	1 31	1 34	1 38	1 41	1 44	1 47	1 48			25
1 12	1 14	1 16	1 18	1 20	1 22	1 23	1 26	1 29	1 31	1 35	1 38	1 41	1 42	1 44			26
1 12	1 14	1 14	1 16	1 18	1 20	1 21	1 23	1 26	1 27	1 31	1 34	1 37	1 38	1 40			27
1 12	1 13	1 13	1 15	1 15	1 17	1 18	1 22	1 25	1 26	1 28	1 30	1 33	1 34	1 36	1 39		28
1 12	1 13	1 13	1 14	1 14	1 15	1 16	1 20	1 23	1 24	1 26	1 29	1 31	1 33	1 34	1 35		29
1 11	1 13	1 11	1 13	1 13	1 15	1 15	1 18	1 21	1 22	1 23	1 26	1 28	1 30	1 31	1 33		30
1 11	1 12	1 11	1 12	1 12	1 14	1 14	1 16	1 19	1 20	1 21	1 23	1 25	1 27	1 28	1 30		31
1 10	1 10	1 10	1 11	1 12	1 13	1 13	1 15	1 18	1 19	1 19	1 22	1 22	1 24	1 26	1 28	1 29	32
1 10	1 9	1 9	1 11	1 11	1 12	1 12	1 14	1 16	1 18	1 18	1 19	1 21	1 23	1 24	1 25	1 26	33
1 10	1 9	1 8	1 9	1 9	1 11	1 11	1 13	1 15	1 16	1 16	1 16	1 18	1 20	1 21	1 22	1 23	34
1 10	1 8	1 8	1 9	1 9	1 10	1 10	1 12	1 13	1 14	1 14	1 15	1 17	1 18	1 19	1 20	1 21	35
1 10	1 9	1 8	1 7	1 7	1 9	1 9	1 10	1 11	1 12	1 12	1 14	1 15	1 15	1 15	1 18	1 19	36
1 10	1 9	1 8	1 7	1 7	1 8	1 8	1 9	1 10	1 11	1 12	1 12	1 13	1 13	1 14	1 17	1 18	37
1 10	1 9	1 8	1 7	1 7	1 8	1 8	1 8	1 10	1 10	1 11	1 12	1 12	1 12	1 13	1 15	1 16	38
1 10	1 9	1 8	1 7	1 6	1 7	1 7	1 7	1 8	1 9	1 10	1 10	1 11	1 11	1 11	1 13	1 13	39
1 11	1 10	1 8	1 7	1 6	1 7	1 6	1 6	1 7	1 8	1 8	1 9	1 10	1 9	1 9	1 11	1 11	40
1 11	1 10	1 8	1 7	1 6	1 6	1 5	1 6	1 6	1 7	1 7	1 7	1 8	1 8	1 8	1 8		41
1 11	1 10	1 8	1 7	1 5	1 5	1 4	1 6	1 6	1 6	1 6	1 6	1 7	1 7	1 7	1 7		42
1 11	1 10	1 8	1 7	1 5	1 5	1 3	1 5	1 5	1 6	1 5	1 5	1 6	1 6	1 6	1 6		43
1 11	1 10	1 8	1 7	1 5	1 5	1 3	1 4	1 4	1 5	1 4	1 4	1 5	1 5	1 5	1 5		44
1 11	1 10	1 8	1 7	1 5	1 5	1 3	1 3	1 3	1 3	1 3	1 3	1 4	1 4	1 4			46
1 11	1 10	1 8	1 7	1 5	1 4	1 3	1 2	1 2	1 2	1 2	1 2	1 3	1 3	1 2			48
1 12	1 11	1 8	1 7	1 5	1 4	1 3	1 2	1 1	1 0	1 0	1 1	1 1	1 1				50
1 12	1 11	1 9	1 7	1 5	1 4	1 2	1 1	1 0	0 58	0 58	0 58	0 59	0 59				52
1 13	1 11	1 9	1 8	1 5	1 4	1 2	1 1	1 0	0 58	0 58	0 58	0 59					54
1 14	1 12	1 10	1 9	1 7	1 5	1 3	1 2	1 0	0 58	0 58	0 58	0 58					56
1 15	1 13	1 10	1 10	1 8	1 5	1 3	1 2	1 0	0 58	0 57	0 58						58
1 16	1 14	1 11	1 11	1 9	1 6	1 4	1 2	1 1	0 58	0 57	0 58						60
1 18	1 15	1 12	1 11	1 9	1 7	1 5	1 3	1 1	0 58	0 56							62
1 19	1 16	1 13	1 11	1 9	1 7	1 6	1 3	1 1	0 57	0 56							64
1 20	1 17	1 14	1 12	1 9	1 7	1 6	1 3	1 1	0 57								66
1 20	1 18	1 14	1 12	1 9	1 8	1 6	1 3	1 1	0 57								68
1 20	1 18	1 15	1 12	1 10	1 8	1 6	1 3	1 1									70
1 21	1 18	1 15	1 12	1 10	1 9	1 6	1 3	1 1									72
1 21	1 18	1 15	1 12	1 11	1 9	1 7	1 4										74
1 21	1 18	1 15	1 12	1 11	1 9	1 7	1 4										76
1 22	1 19	1 15	1 13	1 12	1 10	1 7											78
1 22	1 19	1 15	1 13	1 12	1 10	1 7											80
1 22	1 19	1 15	1 13	1 12	1 11												82
1 23	1 19	1 15	1 13	1 12													84
1 23	1 20	1 16	1 13														86
34°	36°	38°	40°	42°	44°	46°	50°	54°	58°	62°	66°	70°	74°	78°	82°	86°	

TABLE 36.

Apparent Distance, 58°

☾'s Alt.	Apparent Altitude of the Sun or Star.																
	6°	7°	8°	9°	10°	11°	12°	14°	16°	18°	20°	22°	24°	26°	28°	30°	32°
	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″
6°	1 17	1 18	1 20	1 25	1 30	1 37	1 44	1 58	2 14	2 31	2 48	3 5	3 21	3 39	3 57	4 14	4 30
7	1 18	1 17	1 18	1 20	1 24	1 28	1 33	1 44	1 57	2 11	2 25	2 39	2 53	3 8	3 24	3 38	3 52
8	1 23	1 19	1 17	1 19	1 22	1 24	1 27	1 38	1 47	1 56	2 7	2 19	2 31	2 44	2 56	3 8	3 20
9	1 29	1 23	1 20	1 18	1 19	1 21	1 24	1 29	1 37	1 45	1 55	2 5	2 16	2 27	2 38	2 48	2 59
10	1 36	1 28	1 22	1 20	1 18	1 20	1 22	1 26	1 32	1 38	1 46	1 55	2 3	2 13	2 23	2 32	2 41
11	1 43	1 33	1 26	1 22	1 19	1 19	1 20	1 23	1 28	1 33	1 39	1 47	1 54	2 2	2 11	2 20	2 27
12	1 51	1 39	1 31	1 25	1 21	1 20	1 19	1 22	1 25	1 29	1 34	1 40	1 46	1 53	2 1	2 8	2 15
13	1 58	1 45	1 35	1 29	1 24	1 21	1 19	1 20	1 23	1 27	1 30	1 36	1 41	1 47	1 53	1 59	2 6
14	2 6	1 51	1 39	1 33	1 26	1 23	1 21	1 18	1 21	1 24	1 26	1 32	1 36	1 41	1 46	1 51	1 57
15	2 15	1 58	1 44	1 37	1 31	1 27	1 24	1 19	1 19	1 21	1 23	1 27	1 31	1 36	1 41	1 45	1 49
16	2 23	2 4	1 50	1 42	1 35	1 30	1 26	1 20	1 18	1 19	1 20	1 22	1 25	1 29	1 34	1 38	1 42
17	2 31	2 10	1 56	1 46	1 39	1 34	1 28	1 21	1 18	1 18	1 19	1 20	1 22	1 26	1 30	1 34	1 38
18	2 39	2 17	2 1	1 51	1 43	1 37	1 31	1 23	1 19	1 17	1 18	1 19	1 20	1 23	1 27	1 30	1 33
19	2 48	2 24	2 7	1 56	1 47	1 40	1 34	1 25	1 20	1 18	1 17	1 18	1 19	1 21	1 24	1 27	1 30
20	2 56	2 31	2 13	2 1	1 51	1 43	1 36	1 26	1 21	1 19	1 16	1 17	1 18	1 19	1 22	1 24	1 26
21	3 5	2 39	2 19	2 6	1 55	1 47	1 39	1 29	1 22	1 20	1 17	1 16	1 17	1 18	1 20	1 22	1 25
22	3 14	2 46	2 25	2 11	1 59	1 50	1 42	1 31	1 24	1 21	1 18	1 15	1 16	1 17	1 18	1 20	1 22
23	3 22	2 53	2 31	2 16	2 3	1 53	1 45	1 33	1 26	1 22	1 19	1 16	1 16	1 16	1 17	1 19	1 21
24	3 31	3 1	2 38	2 21	2 7	1 57	1 49	1 36	1 28	1 23	1 20	1 17	1 15	1 16	1 17	1 18	1 20
25	3 40	3 8	2 44	2 27	2 11	2 1	1 52	1 38	1 30	1 24	1 21	1 17	1 15	1 16	1 16	1 17	1 18
26	3 49	3 16	2 50	2 32	2 17	2 5	1 56	1 41	1 32	1 26	1 22	1 18	1 16	1 16	1 16	1 16	1 17
27	3 58	3 24	2 57	2 38	2 22	2 10	2 0	1 44	1 35	1 28	1 23	1 19	1 16	1 15	1 16	1 15	1 16
28	4 6	3 31	3 3	2 44	2 27	2 14	2 4	1 49	1 37	1 30	1 24	1 20	1 17	1 15	1 15	1 15	1 15
29	4 14	3 38	3 9	2 49	2 31	2 18	2 7	1 50	1 39	1 31	1 25	1 21	1 17	1 15	1 15	1 15	1 14
30	4 22	3 46	3 15	2 55	2 36	2 22	2 11	1 53	1 42	1 33	1 27	1 22	1 18	1 16	1 15	1 15	1 14
31	4 31	3 54	3 22	3 0	2 41	2 26	2 15	1 56	1 45	1 35	1 28	1 23	1 19	1 17	1 16	1 15	1 14
32	4 39	4 1	3 28	3 5	2 46	2 30	2 18	1 59	1 47	1 37	1 29	1 24	1 20	1 18	1 16	1 15	1 14
33	4 47	4 7	3 34	3 10	2 51	2 35	2 21	2 2	1 49	1 39	1 31	1 25	1 21	1 18	1 17	1 15	1 14
34	4 55	4 14	3 40	3 15	2 56	2 39	2 25	2 5	1 51	1 41	1 33	1 26	1 22	1 19	1 17	1 15	1 14
35	5 2	4 21	3 46	3 21	3 0	2 43	2 29	2 8	1 53	1 42	1 34	1 27	1 22	1 19	1 17	1 15	1 14
36	5 10	4 28	3 52	3 26	3 5	2 47	2 33	2 10	1 55	1 43	1 35	1 28	1 23	1 20	1 18	1 16	1 14
37	5 18	4 34	3 58	3 31	3 9	2 51	2 36	2 13	1 57	1 44	1 36	1 29	1 24	1 21	1 18	1 16	1 14
38	5 26	4 41	4 4	3 36	3 13	2 55	2 40	2 16	1 59	1 46	1 38	1 30	1 25	1 22	1 19	1 17	1 15
39	5 32	4 47	4 9	3 41	3 17	2 58	2 42	2 18	2 1	1 48	1 39	1 31	1 26	1 22	1 19	1 17	1 15
40	5 40	4 53	4 15	3 45	3 22	3 2	2 45	2 20	2 4	1 50	1 41	1 32	1 27	1 23	1 20	1 18	1 16
41	5 47	4 59	4 20	3 50	3 26	3 6	2 49	2 22	2 6	1 52	1 42	1 33	1 28	1 24	1 21	1 18	1 16
42	5 54	5 5	4 25	3 55	3 30	3 10	2 53	2 26	2 9	1 54	1 43	1 34	1 29	1 25	1 22	1 19	1 16
43	6 2	5 12	4 31	3 59	3 34	3 13	2 56	2 29	2 12	1 56	1 45	1 36	1 30	1 26	1 23	1 20	1 17
44	6 10	5 19	4 36	4 4	3 38	3 17	2 59	2 32	2 16	1 58	1 47	1 38	1 31	1 27	1 24	1 20	1 18
46	6 23	5 30	4 45	4 12	3 44	3 24	3 4	2 37	2 20	2 0	1 50	1 40	1 32	1 28	1 25	1 21	1 18
48	6 37	5 41	4 55	4 21	3 51	3 29	3 10	2 42	2 23	2 3	1 54	1 44	1 35	1 30	1 26	1 22	1 19
50	6 50	5 52	5 5	4 29	3 59	3 35	3 16	2 47	2 26	2 7	1 56	1 46	1 38	1 32	1 28	1 23	1 20
52	7 1	6 2	5 14	4 37	4 5	3 42	3 21	2 51	2 29	2 11	1 59	1 49	1 40	1 34	1 30	1 25	1 21
54	7 12	6 12	5 23	4 44	4 12	3 49	3 27	2 56	2 33	2 15	2 2	1 50	1 41	1 37	1 31	1 26	1 22
56	7 23	6 21	5 30	4 51	4 19	3 54	3 32	3 1	2 38	2 19	2 5	1 52	1 43	1 38	1 32	1 27	1 23
58	7 34	6 30	5 38	4 58	4 26	4 0	3 38	3 5	2 42	2 22	2 8	1 54	1 45	1 39	1 33	1 28	1 24
60	7 44	6 38	5 44	5 4	4 32	4 4	3 43	3 9	2 45	2 25	2 10	1 56	1 47	1 40	1 34	1 29	1 25
62	7 53	6 45	5 51	5 10	4 37	4 9	3 48	3 13	2 48	2 28	2 12	1 59	1 48	1 41	1 35	1 30	1 26
64	8 0	6 52	5 58	5 15	4 41	4 13	3 51	3 17	2 51	2 30	2 14	2 1	1 50	1 42	1 36	1 31	1 27
66			6 5	5 22	4 46	4 18	3 55	3 21	2 53	2 32	2 16	2 2	1 51	1 43	1 37	1 32	1 28
68					4 51	4 23	3 59	3 25	2 55	2 34	2 17	2 4	1 52	1 44	1 38	1 33	1 29
70							4 4	3 29	2 58	2 37	2 19	2 6	1 54	1 45	1 39	1 34	1 30
72								3 22	3 0	2 40	2 21	2 7	1 55	1 46	1 40	1 34	1 30
74									3 2	2 43	2 22	2 9	1 56	1 47	1 40	1 34	1 30
76										2 45	2 23	2 10	1 57	1 48	1 40	1 34	1 30
78											2 24	2 10	1 57	1 48	1 40	1 34	1 30
80												2 10	1 58	1 49	1 41	1 34	1 31
82													1 59	1 50	1 42	1 34	1 31
84														1 50	1 42	1 35	1 31
86															1 42	1 35	1 32
	6°	7°	8°	9°	10°	11°	12°	14°	16°	18°	20°	22°	24°	26°	28°	30°	32°

TABLE 36.

Apparent Distance, 58°

Apparent Altitude of the Sun or Star.

4°	36°	38°	40°	42°	44°	46°	50°	54°	58°	62°	66°	70°	74	78	82°	86°	☾'s Alt.
″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	
47	5 3	5 19	5 34	5 48	6 2	6 16	6 43	7 7	7 30	7 51							6°
7	4 21	4 35	4 48	5 0	5 13	5 24	5 46	6 6	6 26	6 43							7
33	3 45	3 58	4 10	4 20	4 31	4 40	4 59	5 18	5 37	5 51	6 3						8
10	3 20	3 31	3 41	3 51	4 0	4 9	4 25	4 41	4 57	5 10	5 21						9
51	3 0	3 9	3 18	3 26	3 35	3 42	3 58	4 12	4 24	4 36	4 47						10
36	2 44	2 52	3 0	3 7	3 15	3 22	3 36	3 49	4 0	4 12	4 20						11
23	2 30	2 37	2 44	2 50	2 57	3 4	3 17	3 28	3 38	3 49	3 57	4 2					12
13	2 20	2 27	2 33	2 39	2 45	2 50	3 1	3 13	3 22	3 32	3 41	3 46					13
3	2 10	2 16	2 22	2 27	2 33	2 37	2 48	2 58	3 7	3 16	3 23	3 28					14
55	2 1	2 6	2 12	2 17	2 22	2 26	2 35	2 45	2 53	3 1	3 8	3 12					15
47	1 52	1 57	2 2	2 6	2 10	2 14	2 23	2 34	2 38	2 46	2 52	2 56	2 59				16
42	1 46	1 50	1 55	1 59	2 3	2 7	2 15	2 23	2 30	2 36	2 42	2 45	2 48				17
37	1 41	1 45	1 49	1 52	1 56	1 59	2 7	2 14	2 20	2 26	2 31	2 34	2 37				18
33	1 37	1 41	1 45	1 48	1 52	1 54	2 1	2 7	2 13	2 19	2 23	2 26	2 28				19
29	1 32	1 36	1 40	1 42	1 46	1 48	1 54	1 59	2 4	2 10	2 14	2 16	2 18	2 20			20
28	1 30	1 34	1 37	1 39	1 43	1 45	1 51	1 55	2 0	2 5	2 8	2 11	2 12	2 14			21
25	1 27	1 30	1 33	1 34	1 37	1 39	1 44	1 49	1 53	1 58	2 1	2 3	2 4	2 8			22
23	1 25	1 27	1 30	1 31	1 34	1 35	1 40	1 45	1 48	1 53	1 57	1 59	1 58	2 1			23
22	1 24	1 26	1 28	1 29	1 32	1 33	1 37	1 41	1 44	1 48	1 53	1 55	1 54	1 55	1 59		24
19	1 21	1 23	1 25	1 26	1 28	1 30	1 33	1 37	1 41	1 45	1 47	1 49	1 50	1 51	1 54		25
18	1 19	1 21	1 24	1 25	1 26	1 27	1 31	1 34	1 37	1 41	1 43	1 44	1 45	1 48	1 49		26
17	1 18	1 20	1 21	1 22	1 23	1 25	1 28	1 32	1 35	1 38	1 40	1 41	1 42	1 44	1 46		27
16	1 17	1 18	1 19	1 19	1 21	1 22	1 26	1 29	1 31	1 34	1 37	1 38	1 38	1 40	1 42	1 43	28
14	1 15	1 16	1 17	1 18	1 19	1 20	1 24	1 27	1 29	1 32	1 33	1 34	1 35	1 37	1 38	1 39	29
14	1 15	1 15	1 16	1 17	1 18	1 19	1 22	1 25	1 27	1 30	1 31	1 32	1 33	1 34	1 36	1 37	30
14	1 15	1 15	1 16	1 16	1 17	1 18	1 21	1 24	1 27	1 30	1 30	1 31	1 32	1 33	1 35	1 36	31
14	1 14	1 14	1 15	1 15	1 16	1 17	1 20	1 22	1 24	1 27	1 28	1 29	1 29	1 31	1 32	1 33	32
14	1 13	1 14	1 15	1 15	1 15	1 15	1 17	1 20	1 22	1 25	1 25	1 27	1 27	1 28	1 30	1 30	33
13	1 13	1 14	1 14	1 14	1 14	1 14	1 16	1 17	1 19	1 22	1 22	1 24	1 24	1 25	1 27	1 27	34
13	1 13	1 14	1 14	1 13	1 13	1 13	1 15	1 17	1 18	1 21	1 21	1 22	1 22	1 23	1 25	1 25	35
13	1 13	1 13	1 13	1 13	1 13	1 13	1 14	1 16	1 17	1 19	1 19	1 21	1 21	1 22	1 24	1 24	36
13	1 13	1 13	1 13	1 12	1 12	1 12	1 14	1 15	1 16	1 18	1 18	1 19	1 19	1 21	1 21		37
13	1 13	1 13	1 13	1 12	1 12	1 12	1 13	1 14	1 15	1 17	1 17	1 17	1 17	1 19	1 19		38
13	1 13	1 12	1 12	1 11	1 11	1 11	1 12	1 13	1 14	1 16	1 16	1 16	1 16	1 17	1 17		39
14	1 13	1 12	1 12	1 11	1 11	1 11	1 11	1 12	1 13	1 15	1 15	1 15	1 15	1 16	1 16		40
14	1 13	1 12	1 11	1 10	1 10	1 10	1 10	1 11	1 12	1 14	1 14	1 14	1 13	1 15			41
15	1 13	1 12	1 11	1 10	1 10	1 9	1 9	1 11	1 11	1 13	1 13	1 13	1 12	1 14			42
15	1 13	1 12	1 11	1 10	1 10	1 9	1 9	1 10	1 10	1 12	1 12	1 12	1 11	1 13			43
16	1 14	1 12	1 11	1 10	1 10	1 9	1 9	1 9	1 9	1 11	1 10	1 11	1 10	1 12			44
16	1 14	1 12	1 11	1 10	1 9	1 8	1 8	1 8	1 8	1 9	1 8	1 8	1 8				46
17	1 14	1 12	1 11	1 10	1 9	1 8	1 8	1 8	1 7	1 8	1 7	1 7	1 7				48
18	1 15	1 13	1 11	1 10	1 9	1 8	1 8	1 7	1 6	1 7	1 7	1 7					50
18	1 16	1 14	1 12	1 10	1 9	1 8	1 8	1 7	1 6	1 6	1 6	1 6					52
19	1 16	1 14	1 12	1 10	1 9	1 8	1 7	1 6	1 6	1 5	1 5						54
20	1 17	1 15	1 13	1 10	1 9	1 8	1 7	1 6	1 5	1 4	1 4						56
21	1 18	1 16	1 14	1 11	1 10	1 8	1 7	1 6	1 5	1 4							58
22	1 19	1 16	1 14	1 11	1 10	1 9	1 7	1 6	1 5	1 4							60
23	1 20	1 17	1 15	1 12	1 10	1 9	1 8	1 6	1 5								62
24	1 21	1 18	1 16	1 13	1 11	1 9	1 8	1 6	1 5								64
25	1 21	1 19	1 17	1 14	1 12	1 10	1 8	1 6									66
26	1 21	1 19	1 17	1 14	1 12	1 10	1 8	1 6									68
27	1 22	1 20	1 18	1 15	1 12	1 10	1 8										70
27	1 22	1 20	1 18	1 15	1 13	1 10	1 8										72
27	1 23	1 20	1 18	1 15	1 13	1 10											74
27	1 23	1 20	1 18	1 15	1 13	1 10											76
27	1 23	1 21	1 18	1 15	1 13												78
27	1 23	1 21	1 18	1 15													80
27	1 23	1 21	1 18														82
28	1 23	1 21															84
28	1 24																86

TABLE 36.

Apparent Distance, 62°

Apparent Altitude of the Sun or Star.*

☽'s Alt.	6°	7°	8°	9°	10°	11°	12°	14°	16°	18°	20°	22°	24°	26°	28°	30°	32'
	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	″ ′	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″
6	1 24	1 25	1 27	1 30	1 35	1 41	1 48	2 2	2 17	2 34	2 51	3 8	3 24	3 40	3 57	4 13	4 30
7	1 26	1 24	1 25	1 27	1 30	1 34	1 38	1 49	2 1	2 14	2 28	2 42	2 56	3 9	3 22	3 36	3 50
8	1 30	1 26	1 24	1 25	1 27	1 29	1 32	1 40	1 49	2 0	2 12	2 24	2 36	2 48	3 0	3 11	3 22
9	1 35	1 29	1 26	1 24	1 25	1 26	1 28	1 34	1 41	1 59	1 59	2 9	2 19	2 30	2 40	2 51	3 0
10	1 41	1 34	1 29	1 25	1 24	1 25	1 26	1 30	1 35	1 42	1 50	1 58	2 7	2 16	2 26	2 35	2 43
11	1 48	1 39	1 32	1 28	1 25	1 24	1 25	1 27	1 31	1 37	1 43	1 50	1 58	2 6	2 14	2 22	2 30
12	1 56	1 44	1 37	1 31	1 27	1 25	1 24	1 26	1 29	1 33	1 38	1 44	1 50	1 57	2 4	2 12	2 19
13	2 4	1 50	1 40	1 34	1 30	1 27	1 25	1 25	1 27	1 30	1 34	1 38	1 44	1 50	1 56	2 3	2 9
14	2 11	1 56	1 46	1 38	1 33	1 30	1 27	1 24	1 26	1 28	1 31	1 34	1 39	1 44	1 50	1 55	2 1
15	2 19	2 2	1 51	1 43	1 36	1 31	1 29	1 25	1 24	1 26	1 28	1 31	1 35	1 39	1 44	1 49	1 54
16	2 27	2 8	1 55	1 46	1 40	1 35	1 30	1 26	1 23	1 24	1 26	1 28	1 31	1 35	1 39	1 44	1 45
17	2 35	2 14	2 0	1 51	1 44	1 38	1 32	1 27	1 24	1 23	1 24	1 26	1 29	1 32	1 35	1 39	1 43
18	2 43	2 21	2 5	1 55	1 47	1 41	1 36	1 29	1 25	1 23	1 23	1 24	1 26	1 29	1 32	1 35	1 38
19	2 51	2 27	2 11	2 0	1 51	1 44	1 38	1 30	1 26	1 23	1 23	1 23	1 25	1 27	1 29	1 32	1 34
20	2 59	2 34	2 17	2 5	1 55	1 47	1 41	1 32	1 27	1 24	1 22	1 22	1 23	1 25	1 27	1 29	1 31
21	3 7	2 41	2 23	2 9	2 0	1 51	1 43	1 34	1 28	1 24	1 22	1 21	1 22	1 23	1 25	1 26	1 28
22	3 15	2 48	2 29	2 14	2 3	1 54	1 46	1 36	1 29	1 25	1 23	1 21	1 21	1 22	1 23	1 24	1 26
23	3 23	2 55	2 35	2 19	2 7	1 58	1 49	1 38	1 31	1 26	1 23	1 21	1 21	1 22	1 22	1 23	1 25
24	3 31	3 2	2 41	2 25	2 11	2 2	1 53	1 41	1 32	1 27	1 24	1 22	1 21	1 21	1 22	1 23	1 24
25	3 40	3 8	2 47	2 29	2 16	2 5	1 56	1 43	1 34	1 28	1 25	1 23	1 21	1 21	1 21	1 22	1 23
26	3 48	3 15	2 53	2 34	2 20	2 9	2 0	1 46	1 36	1 30	1 26	1 23	1 21	1 21	1 21	1 21	1 22
27	3 54	3 22	2 59	2 39	2 25	2 13	2 3	1 49	1 39	1 32	1 27	1 24	1 22	1 21	1 20	1 21	1 21
28	4 5	3 29	3 5	2 44	2 30	2 17	2 7	1 52	1 41	1 33	1 28	1 24	1 22	1 21	1 20	1 20	1 21
29	4 13	3 36	3 11	2 50	2 34	2 21	2 11	1 54	1 43	1 35	1 29	1 25	1 23	1 21	1 20	1 20	1 20
30	4 21	3 43	3 17	2 54	2 38	2 25	2 15	1 57	1 45	1 36	1 30	1 26	1 23	1 21	1 20	1 20	1 20
31	4 29	3 50	3 23	3 0	2 43	2 29	2 18	2 0	1 47	1 38	1 31	1 27	1 24	1 22	1 20	1 20	1 20
32	4 37	3 56	3 29	3 5	2 47	2 33	2 21	2 3	1 49	1 39	1 32	1 28	1 24	1 22	1 21	1 20	1 19
33	4 45	4 3	3 34	3 10	2 52	2 37	2 25	2 6	1 52	1 41	1 34	1 28	1 25	1 22	1 21	1 20	1 19
34	4 53	4 10	3 40	3 15	2 56	2 41	2 28	2 8	1 54	1 42	1 35	1 29	1 26	1 23	1 21	1 20	1 19
35	5 1	4 16	3 46	3 20	3 0	2 45	2 33	2 11	1 56	1 44	1 36	1 30	1 26	1 23	1 21	1 20	1 19
36	5 8	4 22	3 52	3 24	3 4	2 49	2 36	2 14	1 58	1 46	1 38	1 32	1 27	1 24	1 22	1 20	1 19
37	5 16	4 29	3 57	3 30	3 9	2 53	2 40	2 17	2 0	1 48	1 39	1 33	1 28	1 25	1 23	1 21	1 19
38	5 23	4 36	4 3	3 34	3 13	2 56	2 43	2 20	2 3	1 50	1 41	1 34	1 29	1 25	1 23	1 21	1 19
39	5 30	4 43	4 8	3 39	3 17	3 0	2 46	2 23	2 5	1 52	1 43	1 36	1 30	1 26	1 23	1 21	1 19
40	5 37	4 49	4 14	3 44	3 21	3 3	2 49	2 26	2 7	1 54	1 44	1 37	1 31	1 27	1 24	1 22	1 20
41	5 44	4 55	4 19	3 49	3 26	3 8	2 52	2 28	2 9	1 56	1 46	1 38	1 32	1 28	1 24	1 22	1 20
42	5 51	5 1	4 24	3 53	3 30	3 11	2 55	2 31	2 11	1 58	1 47	1 39	1 33	1 29	1 25	1 22	1 20
43	5 58	5 7	4 29	3 58	3 35	3 15	2 59	2 33	2 14	2 0	1 49	1 41	1 35	1 30	1 26	1 23	1 21
44	6 4	5 13	4 34	4 3	3 39	3 19	3 2	2 36	2 16	2 1	1 50	1 42	1 36	1 31	1 27	1 24	1 21
46	6 18	5 23	4 44	4 12	3 46	3 26	3 7	2 41	2 20	2 4	1 53	1 45	1 38	1 32	1 28	1 25	1 21
48	6 31	5 34	4 54	4 20	3 54	3 32	3 13	2 45	2 24	2 9	1 57	1 47	1 40	1 34	1 30	1 26	1 23
50	6 43	5 45	5 2	4 27	4 0	3 38	3 20	2 50	2 28	2 12	2 0	1 49	1 42	1 36	1 31	1 27	1 24
52	6 55	5 55	5 11	4 36	4 8	3 44	3 25	2 55	2 32	2 15	2 3	1 52	1 44	1 37	1 32	1 28	1 25
54	7 7	6 4	5 20	4 43	4 15	3 50	3 30	2 59	2 36	2 19	2 5	1 54	1 46	1 39	1 34	1 29	1 26
56	7 18	6 13	5 28	4 50	4 20	3 55	3 35	3 3	2 39	2 22	2 9	1 57	1 48	1 41	1 35	1 30	1 27
58	7 27	6 21	5 36	4 57	4 26	4 0	3 40	3 7	2 42	2 25	2 11	1 59	1 50	1 43	1 36	1 31	1 27
60	7 36	6 29	5 43	5 3	4 31	4 6	3 44	3 11	2 45	2 28	2 13	2 1	1 52	1 44	1 38	1 33	1 28
62	7 44	6 36	5 48	5 9	4 36	4 11	3 49	3 15	2 49	2 30	2 15	2 3	1 53	1 46	1 39	1 34	1 29
64	7 52	6 43	5 54	5 13	4 41	4 15	3 54	3 19	2 52	2 32	2 17	2 5	1 54	1 47	1 40	1 35	1 30
66	7 59	6 50	6 1	5 19	4 46	4 19	3 58	3 22	2 54	2 34	2 19	2 6	1 56	1 48	1 41	1 36	1 31
68	8 5	6 56	6 5	5 23	4 50	4 23	4 2	3 24	2 56	2 36	2 20	2 7	1 57	1 49	1 42	1 36	1 31
70			6 9	5 27	4 53	4 26	4 4	3 26	2 58	2 38	2 21	2 8	1 58	1 50	1 43	1 37	1 32
72					4 57	4 29	4 6	3 28	3 0	2 39	2 22	2 9	1 59	1 51	1 43	1 37	1 32
74							4 8	3 30	3 2	2 40	2 23	2 10	2 0	1 52	1 44	1 38	1 33
76								3 31	3 4	2 42	2 24	2 11	2 1	1 52	1 44	1 38	1 33
78									3 5	2 43	2 25	2 12	2 1	1 52	1 45	1 39	1 3[illegible]
80										2 44	2 26	2 13	2 2	1 53	1 45	1 39	1 34
82											2 27	2 14	2 2	1 53	1 46	1 40	1 35
84												2 14	2 3	1 54	1 46	1 40	1 35
86													2 3	1 54	1 46	1 40	1 35

TABLE 36.

APPARENT DISTANCE, 62°

Apparent Altitude of the Sun or Star.

34°	36°	38°	40°	42°	44°	46°	50°	54°	58°	62°	66°	70°	74°	78°	82°	86°	☾'s Alt.
′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	
4 46	5 1	5 17	5 31	5 46	5 59	6 13	6 40	7 3	7 24	7 43	7 58						6°
4 3	4 17	4 30	4 42	4 55	5 7	5 19	5 40	6 0	6 18	6 35	6 49						7
3 34	3 46	3 57	4 9	4 20	4 30	4 40	4 59	5 17	5 33	5 48	6 0	6 10					8
3 10	3 20	3 30	3 40	3 49	3 57	4 7	4 24	4 39	4 53	5 6	5 17	5 28					9
2 52	3 1	3 10	3 18	3 27	3 35	3 42	3 57	4 10	4 22	4 33	4 43	4 52					10
2 37	2 45	2 53	3 0	3 8	3 15	3 22	3 35	3 47	3 58	4 8	4 17	4 25					11
2 25	2 33	2 40	2 46	2 53	2 59	3 5	3 17	3 28	3 38	3 47	3 56	4 3	4 8				12
2 15	2 22	2 28	2 34	2 40	2 45	2 51	3 1	3 11	3 20	3 29	3 37	3 43	3 47				13
2 7	2 13	2 18	2 23	2 29	2 34	2 39	2 48	2 57	3 6	3 14	3 20	3 25	3 29				14
1 59	2 4	2 9	2 14	2 19	2 23	2 28	2 37	2 45	2 53	3 0	3 5	3 10	3 14				15
1 52	1 56	2 2	2 6	2 10	2 14	2 19	2 27	2 35	2 42	2 48	2 53	2 57	3 1	3 5			16
1 46	1 50	1 54	1 58	2 2	2 6	2 10	2 18	2 25	2 32	2 38	2 43	2 47	2 51	2 54			17
1 41	1 45	1 48	1 52	1 56	1 59	2 3	2 10	2 17	2 23	2 28	2 33	2 37	2 41	2 43			18
1 37	1 40	1 44	1 47	1 50	1 53	1 57	2 3	2 10	2 16	2 20	2 25	2 29	2 32	2 34			19
1 34	1 36	1 40	1 43	1 46	1 49	1 52	1 57	2 3	2 9	2 13	2 18	2 21	2 24	2 26	2 28		20
1 31	1 33	1 36	1 39	1 42	1 45	1 47	1 52	1 58	2 3	2 7	2 11	2 14	2 16	2 18	2 20		21
1 28	1 31	1 33	1 35	1 38	1 40	1 43	1 48	1 53	1 57	2 1	2 5	2 7	2 9	2 11	2 13		22
1 26	1 28	1 31	1 33	1 35	1 37	1 39	1 44	1 49	1 52	1 56	2 0	2 2	2 4	2 5	2 7		23
1 25	1 26	1 28	1 30	1 32	1 34	1 36	1 41	1 45	1 48	1 52	1 55	1 57	1 59	2 0	2 2	2 4	24
1 24	1 25	1 26	1 28	1 30	1 32	1 33	1 37	1 41	1 45	1 48	1 51	1 53	1 54	1 56	1 57	1 58	25
1 23	1 24	1 25	1 26	1 28	1 30	1 31	1 34	1 38	1 42	1 45	1 47	1 49	1 50	1 52	1 53	1 54	26
1 22	1 23	1 24	1 25	1 26	1 28	1 29	1 32	1 35	1 39	1 42	1 44	1 45	1 47	1 48	1 49	1 50	27
1 21	1 22	1 23	1 23	1 24	1 26	1 27	1 30	1 33	1 36	1 39	1 41	1 42	1 43	1 44	1 45	1 46	28
1 20	1 21	1 22	1 22	1 23	1 24	1 25	1 28	1 30	1 33	1 36	1 38	1 39	1 40	1 41	1 42	1 43	29
1 20	1 20	1 21	1 21	1 22	1 23	1 24	1 26	1 28	1 31	1 33	1 35	1 36	1 37	1 38	1 39	1 40	30
1 20	1 20	1 20	1 20	1 21	1 21	1 22	1 24	1 26	1 29	1 31	1 32	1 33	1 34	1 35	1 36	1 37	31
1 19	1 19	1 19	1 19	1 20	1 20	1 21	1 23	1 25	1 27	1 29	1 30	1 31	1 32	1 33	1 33	1 35	32
1 18	1 18	1 18	1 18	1 19	1 19	1 20	1 21	1 23	1 25	1 27	1 28	1 29	1 30	1 31	1 31		33
1 18	1 18	1 18	1 18	1 18	1 19	1 19	1 20	1 22	1 24	1 25	1 26	1 27	1 28	1 29	1 29		34
1 18	1 18	1 18	1 18	1 18	1 18	1 18	1 19	1 20	1 22	1 23	1 24	1 25	1 26	1 27	1 27		35
1 18	1 17	1 17	1 17	1 17	1 17	1 18	1 18	1 19	1 20	1 21	1 22	1 23	1 24	1 25	1 25		36
1 18	1 17	1 17	1 17	1 17	1 17	1 17	1 17	1 18	1 19	1 20	1 21	1 22	1 23	1 23			37
1 18	1 17	1 16	1 16	1 16	1 16	1 16	1 16	1 17	1 18	1 19	1 20	1 21	1 22	1 22			38
1 18	1 17	1 16	1 16	1 15	1 15	1 15	1 15	1 16	1 17	1 18	1 19	1 19	1 20	1 20			39
1 18	1 17	1 16	1 16	1 15	1 15	1 15	1 15	1 16	1 16	1 17	1 18	1 18	1 19	1 19			40
1 18	1 17	1 16	1 15	1 14	1 14	1 14	1 14	1 15	1 15	1 16	1 17	1 17	1 18				41
1 18	1 17	1 16	1 15	1 14	1 14	1 14	1 14	1 14	1 14	1 15	1 16	1 16	1 17				42
1 19	1 17	1 16	1 15	1 14	1 14	1 13	1 13	1 13	1 13	1 14	1 15	1 15	1 16				43
1 19	1 17	1 16	1 15	1 14	1 14	1 13	1 13	1 13	1 13	1 13	1 14	1 14	1 13				44
1 20	1 18	1 16	1 15	1 14	1 14	1 13	1 12	1 12	1 12	1 12	1 13	1 13					46
1 20	1 18	1 17	1 16	1 14	1 13	1 12	1 12	1 11	1 11	1 11	1 12	1 12					48
1 21	1 19	1 17	1 16	1 14	1 13	1 12	1 11	1 10	1 10	1 10	1 10						50
1 22	1 19	1 17	1 16	1 14	1 13	1 12	1 10	1 10	1 10	1 9	1 9						52
1 23	1 20	1 18	1 17	1 15	1 13	1 12	1 10	1 9	1 9	1 8							54
1 24	1 21	1 18	1 17	1 15	1 13	1 12	1 10	1 9	1 9	1 8							56
1 24	1 21	1 19	1 17	1 15	1 13	1 12	1 10	1 9	1 8								58
1 25	1 22	1 20	1 18	1 16	1 14	1 12	1 10	1 9	1 8								60
1 26	1 23	1 20	1 18	1 16	1 14	1 12	1 10	1 8									62
1 26	1 23	1 20	1 18	1 16	1 14	1 12	1 10	1 8									64
1 27	1 23	1 20	1 18	1 16	1 14	1 12	1 10										66
1 27	1 24	1 21	1 19	1 17	1 15	1 13	1 10										68
1 28	1 24	1 21	1 19	1 17	1 15	1 13											70
1 28	1 25	1 22	1 19	1 17	1 15	1 13											72
1 28	1 25	1 22	1 19	1 17	1 15												74
1 29	1 25	1 22	1 20	1 17													76
1 30	1 26	1 22	1 20														78
1 30	1 26	1 23															80
1 30	1 26																82
1 30																	84
																	86
34°	36°	38°	40°	42°	44°	46°	50°	54°	58°	62°	66°	70°	74°	78°	82°	86°	

TABLE 36.

APPARENT DISTANCE, 66°

Apparent Altitude of the Sun or Star.

☽'s Alt.	6°	7°	8°	9°	10°	11°	12°	14°	16°	18°	20°	22°	24°	26°	28°	30°	32°	☽' Alt
	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	
6°	1 25	1 29	1 31	1 34	1 38	1 43	1 50	2 4	2 20	2 35	2 51	3 7	3 24	3 40	3 55	4 11	4 27	6
7	1 28	1 28	1 29	1 31	1 34	1 37	1 42	1 53	2 4	2 16	2 29	2 43	2 56	3 9	3 22	3 36	3 49	7
8	1 33	1 30	1 28	1 29	1 31	1 33	1 36	1 44	1 53	2 3	2 14	2 25	2 37	2 48	3 0	3 11	3 22	8
9	1 39	1 33	1 30	1 28	1 29	1 30	1 32	1 37	1 45	1 53	2 2	2 11	2 21	2 32	2 42	2 52	3 1	9
10	1 44	1 37	1 31	1 29	1 28	1 29	1 30	1 33	1 39	1 45	1 53	2 0	2 8	2 16	2 26	2 36	2 44	10
11	1 51	1 42	1 35	1 31	1 29	1 28	1 29	1 31	1 35	1 40	1 46	1 53	2 0	2 8	2 16	2 23	2 31	11
12	1 58	1 47	1 39	1 34	1 31	1 29	1 28	1 29	1 32	1 37	1 40	1 46	1 53	1 59	2 6	2 13	2 20	12
13	2 5	1 52	1 43	1 37	1 33	1 31	1 29	1 28	1 30	1 33	1 36	1 40	1 46	1 52	1 58	2 4	2 10	13
14	2 13	1 58	1 48	1 41	1 36	1 33	1 30	1 28	1 29	1 31	1 33	1 37	1 42	1 46	1 52	1 57	2 2	14
15	2 21	2 4	1 53	1 45	1 39	1 35	1 32	1 29	1 28	1 29	1 31	1 34	1 38	1 42	1 46	1 55	1 56	15
16	2 28	2 10	1 58	1 49	1 43	1 38	1 34	1 30	1 27	1 28	1 30	1 32	1 35	1 38	1 42	1 46	1 50	16
17	2 35	2 16	2 3	1 53	1 46	1 41	1 36	1 31	1 28	1 27	1 28	1 30	1 32	1 35	1 38	1 42	1 45	17
18	2 43	2 23	2 8	1 58	1 50	1 44	1 39	1 33	1 29	1 27	1 27	1 28	1 30	1 33	1 34	1 38	1 41	18
19	2 52	2 29	2 14	2 2	1 54	1 47	1 41	1 34	1 30	1 27	1 27	1 27	1 29	1 31	1 33	1 35	1 38	19
20	3 0	2 35	2 19	2 7	1 58	1 51	1 44	1 36	1 31	1 28	1 26	1 27	1 28	1 29	1 31	1 33	1 35	20
21	3 8	2 42	2 25	2 12	2 2	1 54	1 47	1 38	1 32	1 28	1 26	1 26	1 27	1 28	1 29	1 31	1 33	21
22	3 15	2 49	2 31	2 16	2 6	1 57	1 50	1 40	1 33	1 29	1 27	1 25	1 26	1 27	1 28	1 29	1 31	22
23	3 23	2 56	2 36	2 21	2 10	2 1	1 53	1 42	1 35	1 30	1 27	1 25	1 25	1 26	1 27	1 28	1 29	23
24	3 31	3 3	2 42	2 26	2 14	2 4	1 56	1 44	1 37	1 32	1 28	1 26	1 24	1 26	1 26	1 27	1 28	24
25	3 39	3 9	2 48	2 31	2 18	2 8	1 59	1 46	1 39	1 33	1 29	1 27	1 25	1 25	1 25	1 26	1 27	25
26	3 47	3 16	2 54	2 36	2 22	2 12	2 2	1 49	1 41	1 34	1 30	1 28	1 26	1 25	1 25	1 25	1 26	26
27	3 56	3 23	3 0	2 41	2 27	2 15	2 6	1 52	1 42	1 35	1 31	1 28	1 26	1 25	1 24	1 25	1 25	27
28	4 3	3 29	3 5	2 46	2 31	2 19	2 9	1 55	1 44	1 37	1 32	1 29	1 27	1 25	1 24	1 24	1 25	28
29	4 11	3 36	3 11	2 51	2 35	2 23	2 13	1 57	1 46	1 39	1 33	1 30	1 27	1 25	1 24	1 24	1 24	29
30	4 19	3 42	3 17	[illegible] 56	2 40	2 27	2 16	2 0	1 48	1 40	1 34	1 30	1 27	1 26	1 25	1 24	1 24	30
31	4 27	3 49	3 23	3 1	2 44	2 31	2 19	2 2	1 50	1 42	1 35	1 31	1 28	1 26	1 25	1 24	1 24	31
32	4 34	3 55	3 28	3 6	2 49	2 34	2 23	2 5	1 52	1 43	1 36	1 32	1 28	1 26	1 25	1 24	1 23	32
33	4 40	4 2	3 34	3 11	2 53	2 38	2 26	2 8	1 55	1 45	1 38	1 32	1 29	1 27	1 25	1 24	1 23	33
34	4 46	4 8	3 39	3 16	2 57	2 42	2 30	2 10	1 57	1 46	1 39	1 33	1 30	1 28	1 26	1 24	1 23	34
35	4 53	4 15	3 45	3 21	3 2	2 46	2 34	2 13	1 59	1 48	1 41	1 35	1 31	1 28	1 26	1 24	1 23	35
36	5 2	4 21	3 51	3 26	3 6	2 50	2 37	2 16	2 1	1 50	1 42	1 36	1 32	1 29	1 26	1 25	1 23	36
37	5 10	4 28	3 57	3 30	3 10	2 53	2 41	2 19	2 3	1 52	1 44	1 37	1 33	1 29	1 27	1 25	1 23	37
38	5 18	4 34	4 2	3 35	3 14	2 57	2 44	2 21	2 6	1 54	1 46	1 39	1 34	1 30	1 27	1 25	1 23	38
39	5 26	4 40	4 7	3 40	3 18	3 1	2 47	2 24	2 8	1 56	1 48	1 40	1 35	1 31	1 28	1 25	1 23	39
40	5 33	4 46	4 12	3 45	3 22	3 5	2 50	2 27	2 10	1 58	1 49	1 41	1 36	1 32	1 29	1 26	1 24	40
41	5 40	4 52	4 17	3 49	3 26	3 9	2 53	2 30	2 13	2 0	1 51	1 43	1 37	1 32	1 30	1 26	1 24	41
42	5 47	4 58	4 22	3 53	3 30	3 12	2 56	2 32	2 15	2 2	1 52	1 44	1 38	1 33	1 30	1 27	1 25	42
43	5 53	5 4	4 27	3 58	3 34	3 16	2 59	2 34	2 17	2 4	1 54	1 45	1 39	1 34	1 31	1 28	1 25	43
44	6 0	5 10	4 32	4 3	3 38	3 19	3 3	2 37	2 19	2 6	1 55	1 47	1 41	1 35	1 32	1 29	1 26	44
46	6 13	5 20	4 42	4 11	3 46	3 26	3 9	2 42	2 24	2 9	1 57	1 49	1 43	1 37	1 33	1 29	1 26	46
48	6 25	5 31	4 51	4 19	3 53	3 32	3 15	2 46	2 28	2 12	2 0	1 52	1 45	1 39	1 34	1 30	1 27	48
50	6 37	5 41	5 0	4 27	4 0	3 38	3 21	2 51	2 31	2 16	2 3	1 54	1 47	1 40	1 36	1 31	1 28	50
52	6 49	5 50	5 9	4 34	4 7	3 44	3 26	2 56	2 35	2 19	2 6	1 56	1 49	1 42	1 37	1 33	1 29	52
54	7 0	5 59	5 16	4 41	4 13	3 50	3 31	3 0	2 38	2 22	2 9	1 58	1 50	1 44	1 38	1 34	1 30	54
56	7 10	6 8	5 24	4 48	4 19	3 55	3 36	3 4	2 42	2 25	2 12	2 0	1 52	1 45	1 39	1 35	1 31	56
58	7 20	6 16	5 31	4 54	4 25	4 0	3 40	3 8	2 45	2 28	2 14	2 2	1 54	1 47	1 41	1 36	1 32	58
60	7 28	6 26	5 38	5 0	4 30	4 5	3 45	3 12	2 48	2 31	2 16	2 4	1 56	1 49	1 42	1 37	1 33	60
62	7 36	6 31	5 45	5 5	4 35	4 10	3 49	3 15	2 51	2 33	2 18	2 6	1 58	1 50	1 44	1 38	1 34	62
64	7 45	6 38	5 51	5 10	4 40	4 15	3 53	3 19	2 53	2 35	2 21	2 8	1 59	1 51	1 45	1 39	1 35	64
66	7 52	6 44	5 56	5 15	4 44	4 19	3 57	3 22	2 55	2 37	2 23	2 10	2 0	1 52	1 46	1 40	1 36	66
68	7 58	6 50	6 1	5 20	4 48	4 23	4 1	3 24	2 58	2 39	2 24	2 12	2 1	1 53	1 47	1 41	1 36	68
70	8 4	6 56	6 6	5 24	4 52	4 26	4 4	3 27	3 0	2 41	2 25	2 13	2 2	1 54	1 48	1 42	1 37	70
72	8 10	7 1	6 10	5 28	4 56	4 29	4 6	3 29	3 2	2 43	2 26	2 13	2 3	1 55	1 49	1 42	1 37	72
74			6 13	5 31	4 59	4 31	4 8	3 31	3 4	2 44	2 27	2 14	2 4	1 56	1 49	1 43	1 38	74
76					5 1	4 33	4 10	3 33	3 6	2 45	2 28	2 15	2 5	1 56	1 49	1 43	1 38	76
78							4 11	3 34	3 8	2 46	2 29	2 16	2 5	1 56	1 50	1 44	1 39	78
80								3 35	3 9	2 47	2 30	2 17	2 6	1 57	1 50	1 44	1 39	80
82									3 10	2 48	2 31	2 18	2 6	1 57	1 50	1 44	1 39	82
84										2 49	2 31	2 18	2 7	1 58	1 51	1 44		84
86											2 31	2 18	2 8	1 58	1 51			86
	6°	7°	8°	9°	10°	11°	12°	14°	16°	18°	20°	22°	24°	26°	28°	30°	32°	

TABLE 36.

Apparent Distance, 66°

Apparent Altitude of the Sun or Star.

34°	36°	38°	40°	42°	44°	46°	50°	54°	58°	62°	66°	70°	74°	78°	82°	86°	☾'s Alt.
′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	
4 43	4 58	5 13	5 27	5 42	5 55	6 8	6 33	6 55	7 16	7 34	7 50	8 4					6°
4 2	4 13	4 28	4 40	4 53	5 5	5 16	5 36	5 55	6 13	6 29	6 42	6 55					7
3 34	3 45	3 56	4 7	4 18	4 28	4 38	4 56	5 13	5 28	5 42	5 55	6 5	6 13				8
3 11	3 21	3 30	3 39	3 49	3 58	4 7	4 23	4 37	4 51	5 3	5 13	5 23	5 31				9
2 53	3 2	3 10	3 17	3 25	3 33	3 42	3 56	4 9	4 21	4 32	4 41	4 50	4 58				10
2 38	2 46	2 54	3 0	3 9	3 15	3 22	3 35	3 47	3 58	4 8	4 16	4 24	4 30				11
2 26	2 34	2 41	2 46	2 52	2 59	3 6	3 18	3 28	3 38	3 48	3 56	4 3	4 8	4 12			12
2 16	2 23	2 29	2 35	2 41	2 46	2 52	3 2	3 12	3 21	3 30	3 37	3 43	3 48	3 52			13
2 8	2 14	2 19	2 24	2 30	2 35	2 40	2 49	2 58	3 6	3 14	3 20	3 26	3 30	3 34			14
2 1	2 6	2 11	2 15	2 20	2 25	2 30	2 38	2 46	2 54	3 1	3 6	3 11	3 15	3 19			15
1 55	1 59	2 4	2 8	2 12	2 16	2 21	2 29	2 36	2 43	2 49	2 54	2 59	3 3	3 7	3 9		16
1 49	1 54	1 57	2 0	2 5	2 9	2 13	2 21	2 28	2 34	2 39	2 44	2 48	2 52	2 56	2 58		17
1 45	1 49	1 52	1 56	2 0	2 4	2 7	2 13	2 20	2 26	2 31	2 36	2 40	2 43	2 46	2 48		18
1 41	1 44	1 48	1 51	1 54	1 57	2 1	2 7	2 13	2 19	2 24	2 28	2 32	2 35	2 38	2 40		19
1 38	1 41	1 44	1 47	1 50	1 53	1 56	2 1	2 7	2 13	2 17	2 21	2 24	2 27	2 30	2 32	2 33	20
1 35	1 38	1 41	1 43	1 46	1 48	1 51	1 56	2 2	2 7	2 11	2 15	2 18	2 20	2 22	2 24	2 25	21
1 33	1 35	1 38	1 40	1 42	1 45	1 47	1 52	1 57	2 1	2 5	2 8	2 11	2 13	2 15	2 17	2 18	22
1 31	1 33	1 35	1 37	1 39	1 42	1 44	1 48	1 53	1 56	2 0	2 3	2 6	2 8	2 10	2 12	2 13	23
1 29	1 31	1 33	1 34	1 37	1 39	1 41	1 45	1 49	1 52	1 56	1 59	2 1	2 3	2 5	2 7	2 8	24
1 28	1 29	1 31	1 33	1 35	1 36	1 38	1 42	1 45	1 49	1 52	1 55	1 57	1 59	2 0	2 2	2 3	25
1 27	1 29	1 30	1 32	1 33	1 35	1 36	1 39	1 42	1 46	1 49	1 51	1 52	1 55	1 56	1 57	1 58	26
1 26	1 27	1 28	1 30	1 31	1 32	1 34	1 36	1 39	1 43	1 46	1 48	1 50	1 51	1 52	1 53	1 54	27
1 25	1 26	1 27	1 28	1 29	1 30	1 32	1 34	1 37	1 40	1 43	1 45	1 47	1 48	1 49	1 50	1 50	28
1 24	1 25	1 26	1 26	1 27	1 29	1 30	1 32	1 35	1 37	1 40	1 42	1 44	1 48	1 46	1 47		29
1 24	1 25	1 25	1 25	1 26	1 27	1 28	1 30	1 33	1 35	1 37	1 39	1 41	1 42	1 43	1 44		30
1 24	1 24	1 24	1 24	1 25	1 26	1 27	1 29	1 31	1 33	1 35	1 37	1 38	1 39	1 40	1 41		31
1 23	1 23	1 23	1 23	1 24	1 25	1 26	1 27	1 29	1 31	1 33	1 35	1 36	1 37	1 38	1 39		32
1 23	1 23	1 23	1 23	1 24	1 24	1 25	1 26	1 28	1 29	1 31	1 33	1 34	1 35	1 36			33
1 22	1 22	1 22	1 23	1 23	1 23	1 24	1 25	1 27	1 28	1 29	1 31	1 32	1 33	1 34			34
1 22	1 22	1 22	1 22	1 22	1 22	1 23	1 24	1 26	1 27	1 28	1 29	1 30	1 31	1 32			35
1 22	1 21	1 21	1 21	1 21	1 22	1 22	1 23	1 25	1 26	1 27	1 28	1 28	1 29	1 30			36
1 22	1 21	1 21	1 21	1 21	1 21	1 21	1 22	1 24	1 25	1 26	1 27	1 27	1 28				37
1 22	1 21	1 20	1 20	1 20	1 21	1 21	1 22	1 23	1 24	1 25	1 26	1 26	1 27				38
1 22	1 21	1 20	1 20	1 20	1 21	1 21	1 21	1 22	1 23	1 24	1 24	1 25	1 25				39
1 22	1 22	1 21	1 20	1 20	1 20	1 20	1 21	1 21	1 22	1 23	1 23	1 24	1 24				40
1 22	1 22	1 21	1 20	1 19	1 19	1 19	1 20	1 20	1 21	1 22	1 22	1 23					41
1 22	1 22	1 21	1 21	1 19	1 19	1 19	1 19	1 20	1 20	1 21	1 21	1 22					42
1 23	1 22	1 21	1 21	1 19	1 19	1 19	1 19	1 19	1 19	1 20	1 20	1 21					43
1 24	1 22	1 21	1 21	1 19	1 18	1 18	1 18	1 18	1 19	1 19	1 19	1 20					44
1 24	1 23	1 21	1 21	1 19	1 18	1 17	1 18	1 17	1 18	1 18	1 18						46
1 25	1 23	1 22	1 21	1 19	1 18	1 17	1 17	1 16	1 17	1 17	1 17						48
1 26	1 24	1 22	1 21	1 19	1 18	1 18	1 16	1 16	1 16	1 16							50
1 27	1 25	1 23	1 22	1 20	1 19	1 18	1 16	1 15	1 15	1 15							52
1 27	1 25	1 23	1 22	1 20	1 19	1 18	1 16	1 15	1 14								54
1 28	1 26	1 24	1 22	1 20	1 19	1 18	1 16	1 14	1 14								56
1 29	1 26	1 24	1 22	1 21	1 19	1 18	1 16	1 14									58
1 30	1 27	1 25	1 23	1 21	1 19	1 18	1 16	1 14									60
1 31	1 28	1 25	1 23	1 21	1 20	1 18	1 16										62
1 31	1 28	1 25	1 23	1 21	1 20	1 18	1 15										64
1 32	1 29	1 26	1 23	1 21	1 20	1 18											66
1 32	1 29	1 26	1 23	1 22	1 20	1 18											68
1 33	1 30	1 27	1 24	1 22	1 20												70
1 33	1 30	1 27	1 24	1 22													72
1 34	1 30	1 27	1 24														74
1 34	1 30	1 27															76
1 34	1 30																78
1 34																	80
																	82
																	84
																	86
34°	36°	38°	40°	42°	44°	46°	50°	54°	58°	62°	66°	70°	74°	78°	82°	86°	

TABLE 36.

APPARENT DISTANCE, 70°

Apparent Altitude of the Sun or Star.

☾'s Alt.	6°	7°	8°	9°	10°	11°	12°	14°	16°	18°	20°	22°	24°	26°	28°	30°	32°
	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″
6°	1 31	1 33	1 36	1 39	1 43	1 48	1 54	2 7	2 22	2 37	2 52	3 8	3 24	3 40	3 55	4 11	4 26
7	1 34	1 31	1 33	1 34	1 37	1 41	1 45	1 55	2 6	2 19	2 32	2 45	2 58	3 11	3 23	3 37	3 50
8	1 38	1 33	1 31	1 32	1 34	1 36	1 39	1 47	1 56	2 6	2 16	2 27	2 39	2 50	3 1	3 13	3 24
9	1 42	1 36	1 33	1 31	1 32	1 33	1 35	1 40	1 48	1 56	2 5	2 15	2 24	2 34	2 43	2 53	3 3
10	1 46	1 40	1 35	1 32	1 31	1 32	1 33	1 36	1 42	1 48	1 56	2 4	2 12	2 21	2 29	2 38	2 46
11	1 52	1 45	1 38	1 34	1 32	1 31	1 32	1 34	1 38	1 43	1 49	1 56	2 3	2 11	2 18	2 26	2 33
12	1 58	1 50	1 42	1 37	1 34	1 32	1 31	1 32	1 35	1 39	1 44	1 50	1 56	2 2	2 9	2 16	2 22
13	2 5	1 54	1 46	1 41	1 37	1 34	1 32	1 31	1 33	1 36	1 40	1 45	1 50	1 56	2 1	2 7	2 13
14	2 12	2 0	1 51	1 44	1 40	1 36	1 34	1 31	1 32	1 34	1 37	1 41	1 46	1 50	1 55	2 0	2 5
15	2 19	2 6	1 56	1 48	1 42	1 38	1 36	1 32	1 31	1 32	1 34	1 37	1 43	1 46	1 49	1 55	1 59
16	2 27	2 12	2 1	1 52	1 46	1 41	1 37	1 33	1 31	1 31	1 33	1 35	1 38	1 42	1 45	1 50	1 54
17	2 34	2 18	2 6	1 56	1 49	1 44	1 40	1 34	1 32	1 31	1 32	1 33	1 36	1 39	1 42	1 46	1 50
18	2 42	2 25	2 11	2 1	1 53	1 47	1 42	1 36	1 32	1 30	1 31	1 32	1 34	1 37	1 39	1 42	1 46
19	2 50	2 32	2 16	2 6	1 57	1 50	1 44	1 37	1 33	1 30	1 30	1 31	1 33	1 35	1 37	1 39	1 42
20	2 58	2 38	2 23	2 9	2 1	1 53	1 47	1 39	1 34	1 32	1 30	1 31	1 32	1 33	1 35	1 37	1 39
21	3 7	2 44	2 27	2 14	2 4	1 57	1 50	1 41	1 35	1 32	1 30	1 31	1 31	1 32	1 33	1 35	1 37
22	3 15	2 51	2 34	2 19	2 8	2 0	1 53	1 43	1 37	1 33	1 31	1 30	1 31	1 31	1 32	1 33	1 35
23	3 23	2 57	2 39	2 24	2 12	2 4	1 56	1 45	1 39	1 34	1 32	1 30	1 30	1 31	1 31	1 32	1 34
24	3 31	3 5	2 45	2 29	2 17	2 6	1 59	1 48	1 40	1 35	1 32	1 30	1 30	1 30	1 30	1 32	1 33
25	3 39	3 11	2 50	2 34	2 21	2 10	2 2	1 50	1 42	1 36	1 32	1 31	1 30	1 30	1 29	1 31	1 32
26	3 46	3 17	2 56	2 39	2 25	2 14	2 6	1 53	1 45	1 38	1 34	1 31	1 30	1 29	1 29	1 30	1 31
27	3 51	3 24	3 1	2 44	2 29	2 18	2 10	1 55	1 46	1 39	1 35	1 32	1 30	1 29	1 28	1 29	1 30
28	4 1	3 30	3 6	2 48	2 33	2 23	2 12	1 58	1 48	1 41	1 36	1 33	1 31	1 29	1 28	1 29	1 30
29	4 8	3 36	3 12	2 53	2 37	2 25	2 16	2 0	1 50	1 43	1 37	1 33	1 31	1 30	1 28	1 28	1 29
30	4 15	3 43	3 18	2 58	2 41	2 29	2 19	2 3	1 52	1 44	1 38	1 34	1 32	1 30	1 28	1 28	1 29
31	4 23	3 50	3 23	3 3	2 46	2 32	2 22	2 6	1 54	1 47	1 39	1 35	1 32	1 30	1 29	1 28	1 28
32	4 31	3 55	3 28	3 8	2 50	2 36	2 25	2 8	1 56	1 49	1 41	1 33	1 33	1 31	1 29	1 29	1 27
33	4 38	4 2	3 34	3 13	2 55	2 40	2 28	2 12	1 58	1 51	1 42	1 36	1 33	1 31	1 29	1 29	1 27
34	4 46	4 8	3 40	3 18	2 59	2 44	2 31	2 14	2 0	1 52	1 44	1 37	1 34	1 32	1 30	1 29	1 28
35	4 53	4 15	3 45	3 22	3 3	2 47	2 36	2 16	2 2	1 54	1 45	1 39	1 35	1 32	1 30	1 29	1 28
36	5 0	4 21	3 50	3 27	3 7	2 51	2 38	2 18	2 3	1 56	1 46	1 40	1 36	1 33	1 30	1 29	1 28
37	5 7	4 27	3 56	3 31	3 11	2 55	2 42	2 21	2 6	1 58	1 48	1 42	1 37	1 34	1 30	1 29	1 28
38	5 14	4 33	4 1	3 36	3 15	2 59	2 45	2 24	2 9	2 0	1 50	1 43	1 38	1 35	1 31	1 30	1 28
39	5 21	4 39	4 6	3 40	3 19	3 3	2 49	2 26	2 11	2 2	1 51	1 44	1 39	1 36	1 32	1 30	1 29
40	5 28	4 45	4 11	3 45	3 23	3 6	2 52	2 29	2 13	2 4	1 53	1 46	1 41	1 37	1 33	1 31	1 29
41	5 35	4 51	4 16	3 50	3 27	3 10	2 55	2 31	2 16	2 6	1 54	1 47	1 42	1 38	1 33	1 31	1 29
42	5 42	4 57	4 21	3 54	3 31	3 14	2 58	2 33	2 18	2 8	1 56	1 48	1 43	1 39	1 34	1 32	1 30
43	5 49	5 2	4 26	3 59	3 35	3 17	3 1	2 35	2 21	2 10	1 57	1 49	1 44	1 40	1 35	1 32	1 30
44	5 55	5 7	4 31	4 2	3 39	3 20	3 4	2 39	2 24	2 13	1 59	1 51	1 45	1 41	1 36	1 33	1 31
46	6 7	5 18	4 41	4 11	3 46	3 27	3 10	2 41	2 26	2 16	2 1	1 53	1 47	1 42	1 37	1 34	1 31
48	6 19	5 28	4 49	4 18	3 53	3 34	3 16	2 49	2 30	2 20	2 3	1 56	1 49	1 43	1 38	1 35	1 32
50	6 31	5 38	4 58	4 26	4 0	3 39	3 22	2 53	2 34	2 22	2 7	1 58	1 51	1 45	1 40	1 36	1 33
52	6 42	5 47	5 7	4 33	4 6	3 45	3 27	2 57	2 37	2 25	2 10	2 0	1 53	1 47	1 41	1 38	1 34
54	6 53	5 56	5 14	4 40	4 12	3 51	3 32	3 1	2 41	2 29	2 13	2 2	1 55	1 48	1 42	1 39	1 35
56	7 2	6 5	5 22	4 46	4 18	3 56	3 37	3 5	2 44	2 32	2 16	2 4	1 57	1 49	1 43	1 40	1 36
58	7 12	6 13	5 29	4 52	4 24	4 1	3 42	3 9	2 47	2 34	2 18	2 6	1 58	1 51	1 45	1 41	1 37
60	7 21	6 21	5 35	4 58	4 29	4 6	3 46	3 13	2 51	2 36	2 20	2 8	2 0	1 53	1 47	1 42	1 37
62	7 29	6 28	5 42	5 3	4 35	4 10	3 50	3 17	2 54	2 39	2 23	2 10	2 2	1 54	1 48	1 43	1 38
64	7 36	6 34	5 48	5 8	4 39	4 14	3 54	3 20	2 56	2 41	2 24	2 13	2 3	1 55	1 49	1 44	1 39
66	7 44	6 40	5 53	5 13	4 44	4 18	3 58	3 23	2 59	2 43	2 26	2 14	2 4	1 56	1 50	1 45	1 40
68	7 51	6 46	5 58	5 17	4 47	4 23	4 1	3 26	3 1	2 45	2 28	2 16	2 5	1 57	1 51	1 45	1 41
70	7 57	6 51	6 3	5 21	4 52	4 26	4 3	3 29	3 3	2 46	2 29	2 17	2 6	1 58	1 51	1 46	1 41
72	8 4	6 56	6 8	5 25	4 55	4 28	4 6	3 31	3 5	2 47	2 31	2 17	2 7	1 59	1 52	1 47	1 42
74	8 11	7 5	6 11	5 29	4 58	4 30	4 8	3 33	3 7	2 48	2 32	2 18	2 8	2 0	1 53	1 47	1 43
76	8 14	7 9	6 15	5 32	5 1	4 33	4 10	3 34	3 9	2 49	2 32	2 20	2 9	2 0	1 54	1 47	1 43
78			6 18	5 36	5 3	4 34	4 12	3 36	3 10	2 50	2 33	2 20	2 10	2 1	1 54	1 48	1 43
80					5 5	4 36	4 13	3 37	3 12	2 51	2 35	2 21	2 10	2 2	1 55	1 49	
82							4 16	3 39	3 12	2 52	2 35	2 21	2 11	2 2	1 55		
84								3 39	3 13	2 52	2 36	2 22	2 12	2 3			
86									3 13	2 52	2 36	2 22	2 12				

TABLE 36.

Apparent Distance, 70°

Apparent Altitude of the Sun or Star.

34°	36°	38°	40°	42°	44°	46°	50°	54°	58°	62°	66°	70°	74°	78°	82°	86°	☽'s Alt
′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	
4 41	4 56	5 11	5 25	5 39	5 51	6 4	6 28	6 50	7 10	7 28	7 44	7 58	8 10				6°
4 2	4 15	4 28	4 40	4 52	5 3	5 14	5 34	5 52	6 9	6 24	6 37	6 49	7 0				7
3 35	3 46	3 57	4 7	4 18	4 27	4 37	4 55	5 11	5 26	5 39	5 51	6 2	6 10	6 17			8
3 13	3 23	3 32	3 41	3 50	3 58	4 7	4 23	4 37	4 50	5 1	5 11	5 20	5 28	5 36			9
2 55	3 4	3 12	3 19	3 27	3 35	3 43	4 0	4 10	4 22	4 32	4 41	4 50	4 57	5 3			10
2 41	2 49	2 56	3 3	3 10	3 17	3 24	3 36	3 48	3 59	4 9	4 17	4 24	4 30	4 35			11
2 29	2 36	2 43	2 49	2 55	3 1	3 8	3 19	3 30	3 40	3 49	3 56	4 3	4 8	4 12	4 16		12
2 19	2 25	2 31	2 37	2 43	2 48	2 54	3 4	3 14	3 23	3 31	3 38	3 44	3 49	3 53	3 56		13
2 11	2 16	2 22	2 27	2 32	2 37	2 42	2 52	3 0	3 8	3 16	3 22	3 28	3 32	3 36	3 39		14
2 4	2 9	2 14	2 18	2 23	2 27	2 32	2 41	2 49	2 56	3 3	3 9	3 14	3 18	3 22	3 24		15
1 59	2 3	2 7	2 12	2 16	2 20	2 24	2 31	2 39	2 46	2 52	2 57	3 2	3 6	3 10	3 12	3 14	16
1 54	1 57	2 1	2 6	2 9	2 13	2 17	2 23	2 31	2 37	2 43	2 48	2 52	2 55	2 59	3 1	3 2	17
1 49	1 52	1 56	2 0	2 4	2 7	2 11	2 17	2 24	2 29	2 35	2 39	2 43	2 46	2 49	2 51	2 52	18
1 45	1 48	1 52	1 55	1 59	2 2	2 5	2 11	2 17	2 23	2 28	2 32	2 35	2 38	2 41	2 43	2 44	19
1 42	1 45	1 48	1 51	1 54	1 57	2 0	2 5	2 11	2 17	2 21	2 25	2 28	2 31	2 33	2 35	2 36	20
1 39	1 42	1 45	1 47	1 50	1 53	1 55	2 0	2 6	2 11	2 15	2 19	2 22	2 24	2 26	2 27	2 28	21
1 37	1 39	1 42	1 44	1 46	1 49	1 51	1 56	2 1	2 5	2 9	2 13	2 16	2 18	2 20	2 21	2 22	22
1 35	1 37	1 39	1 41	1 43	1 46	1 48	1 52	1 57	2 0	2 4	2 8	2 11	2 13	2 14	2 16	2 17	23
1 34	1 35	1 37	1 39	1 41	1 43	1 45	1 49	1 53	1 56	2 0	2 3	2 6	2 8	2 9	2 11	2 12	24
1 33	1 34	1 36	1 37	1 39	1 40	1 42	1 46	1 49	1 52	1 56	1 59	2 1	2 3	2 4	2 6		25
1 32	1 33	1 34	1 36	1 37	1 38	1 40	1 43	1 46	1 49	1 52	1 55	1 57	1 59	2 0	2 2		26
1 31	1 32	1 33	1 34	1 35	1 37	1 38	1 41	1 43	1 46	1 49	1 52	1 54	1 55	1 56	1 58		27
1 29	1 31	1 32	1 32	1 33	1 34	1 36	1 39	1 41	1 44	1 46	1 49	1 51	1 52	1 53	1 54		28
1 29	1 30	1 31	1 31	1 32	1 33	1 34	1 37	1 39	1 42	1 44	1 46	1 48	1 50	1 51			29
1 29	1 29	1 30	1 30	1 31	1 32	1 33	1 35	1 37	1 40	1 42	1 44	1 45	1 47	1 48			30
1 28	1 29	1 29	1 30	1 30	1 31	1 32	1 34	1 36	1 38	1 40	1 42	1 43	1 44	1 45			31
1 28	1 28	1 28	1 29	1 29	1 30	1 31	1 32	1 34	1 36	1 38	1 40	1 41	1 42	1 43			32
1 27	1 27	1 28	1 29	1 29	1 30	1 30	1 31	1 32	1 34	1 36	1 38	1 39	1 40				33
1 27	1 27	1 27	1 28	1 28	1 29	1 29	1 30	1 31	1 32	1 34	1 36	1 37	1 38				34
1 27	1 27	1 27	1 27	1 27	1 28	1 28	1 29	1 30	1 31	1 33	1 34	1 35	1 36				35
1 27	1 26	1 26	1 26	1 26	1 27	1 27	1 28	1 30	1 31	1 32	1 33	1 33	1 34				36
1 27	1 26	1 26	1 26	1 26	1 26	1 26	1 27	1 29	1 30	1 31	1 32	1 32					37
1 27	1 26	1 25	1 25	1 25	1 26	1 26	1 27	1 28	1 29	1 30	1 31	1 31					38
1 28	1 26	1 25	1 25	1 25	1 26	1 26	1 26	1 27	1 28	1 29	1 30	1 30					39
1 23	1 27	1 26	1 25	1 25	1 25	1 25	1 26	1 26	1 27	1 28	1 28	1 29					40
1 28	1 27	1 26	1 25	1 24	1 24	1 24	1 25	1 25	1 26	1 27	1 27						41
1 28	1 27	1 26	1 25	1 24	1 24	1 24	1 24	1 25	1 25	1 26	1 26						42
1 28	1 27	1 26	1 25	1 24	1 24	1 24	1 24	1 24	1 24	1 25	1 25						43
1 29	1 27	1 26	1 25	1 24	1 23	1 23	1 23	1 23	1 23	1 24	1 24						44
1 29	1 28	1 27	1 26	1 24	1 23	1 23	1 22	1 22	1 23	1 23							46
1 30	1 28	1 27	1 26	1 25	1 23	1 23	1 21	1 21	1 22	1 22							48
1 31	1 29	1 28	1 26	1 25	1 23	1 23	1 21	1 21	1 21								50
1 32	1 29	1 28	1 27	1 25	1 23	1 23	1 21	1 20	1 20								52
32	1 30	1 29	1 27	1 26	1 24	1 23	1 21	1 20									54
33	1 31	1 29	1 27	1 26	1 24	1 23	1 21	1 19									56
34	1 32	1 30	1 28	1 26	1 24	1 23	1 21										58
34	1 32	1 30	1 28	1 26	1 24	1 23	1 21										60
35	1 33	1 30	1 28	1 26	1 24	1 23											62
36	1 33	1 31	1 28	1 26	1 24	1 23											64
36	1 34	1 31	1 29	1 26	1 25												66
37	1 34	1 31	1 29	1 27													68
37	1 34	1 32	1 30														70
38	1 34	1 32															72
38	1 34																74
38																	76
																	78
																	80
																	82
																	84
																	86

TABLE 36.

APPARENT DISTANCE, 74°

Apparent Altitude of the Sun or Star.

☾'s Alt.	6°	7°	8°	9°	10°	11°	12°	14°	16°	16°	20°	22°	24°	26°	28°	30°	32°	☾'s Alt.
	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	
6°	1 31	1 34	1 36	1 40	1 45	1 50	1 56	2 10	2 24	2 40	2 54	3 10	3 25	3 40	3 56	4 12	4 26	
7	1 35	1 35	1 36	1 38	1 41	1 45	1 49	1 59	2 10	2 23	2 36	2 49	3 2	3 13	3 26	3 39	3 52	
8	1 40	1 38	1 35	1 36	1 38	1 40	1 43	1 50	2 0	2 10	2 21	2 32	2 43	2 53	3 4	3 15	3 26	
9	1 45	1 41	1 37	1 35	1 36	1 37	1 39	1 44	1 52	2 0	2 9	2 19	2 28	2 37	2 46	2 56	3 6	
10	1 50	1 44	1 39	1 37	1 35	1 36	1 37	1 40	1 46	1 53	2 0	2 8	2 16	2 24	2 37	2 41	2 50	
11	1 56	1 48	1 42	1 39	1 37	1 35	1 36	1 38	1 42	1 47	1 53	2 0	2 7	2 14	2 21	2 29	2 37	11
12	2 2	1 53	1 46	1 42	1 39	1 36	1 35	1 37	1 39	1 43	1 48	1 54	2 0	2 6	2 13	2 19	2 26	12
13	2 10	1 58	1 50	1 45	1 41	1 38	1 36	1 36	1 37	1 40	1 44	1 49	1 54	2 0	2 6	2 11	2 17	13
14	2 17	2 5	1 54	1 47	1 43	1 40	1 37	1 35	1 36	1 38	1 41	1 45	1 49	1 54	1 59	2 5	2 9	14
15	2 24	2 10	2 0	1 52	1 47	1 43	1 40	1 36	1 35	1 37	1 39	1 42	1 46	1 50	1 54	1 59	2 3	15
16	2 31	2 16	2 5	1 56	1 50	1 45	1 42	1 37	1 35	1 36	1 37	1 40	1 43	1 46	1 50	1 54	1 58	16
17	2 38	2 22	2 10	2 0	1 55	1 48	1 44	1 38	1 36	1 35	1 37	1 38	1 40	1 43	1 46	1 50	1 54	17
18	2 46	2 29	2 15	2 4	1 56	1 50	1 46	1 40	1 37	1 35	1 36	1 37	1 39	1 41	1 44	1 47	1 50	18
19	2 54	2 35	2 20	2 9	2 0	1 53	1 48	1 41	1 38	1 35	1 35	1 36	1 37	1 39	1 41	1 44	1 46	19
20	3 1	2 41	2 28	2 12	2 3	1 56	1 51	1 43	1 39	1 36	1 33	1 35	1 36	1 37	1 39	1 43	1 44	20
21	3 10	2 48	2 31	2 18	2 8	2 0	1 54	1 45	1 40	1 37	1 35	1 35	1 35	1 36	1 37	1 39	1 41	21
22	3 18	2 53	2 37	2 22	2 12	2 4	1 57	1 47	1 42	1 38	1 36	1 34	1 35	1 35	1 36	1 37	1 39	22
23	3 26	3 1	2 42	2 27	2 16	2 7	2 0	1 49	1 43	1 39	1 36	1 34	1 34	1 35	1 35	1 36	1 38	23
24	3 34	3 8	2 48	2 32	2 20	2 10	2 3	1 52	1 45	1 40	1 37	1 35	1 34	1 34	1 34	1 36	1 37	24
25	3 42	3 14	2 53	2 37	2 25	2 14	2 6	1 54	1 47	1 41	1 38	1 35	1 34	1 34	1 34	1 35	1 36	25
26	3 49	3 20	2 59	2 42	2 29	2 18	2 10	1 57	1 48	1 43	1 39	1 36	1 34	1 33	1 33	1 34	1 35	26
27	3 57	3 27	3 4	2 47	2 33	2 22	2 13	2 0	1 51	1 44	1 39	1 37	1 35	1 33	1 33	1 33	1 34	27
28	4 4	3 33	3 9	2 52	2 37	2 26	2 16	2 2	1 52	1 46	1 41	1 37	1 35	1 33	1 32	1 33	1 34	28
29	4 11	3 39	3 14	2 56	2 41	2 29	2 20	2 5	1 54	1 47	1 42	1 38	1 36	1 34	1 33	1 32	1 33	29
30	4 18	3 45	3 23	3 3	2 47	2 33	2 22	2 7	1 56	1 49	1 43	1 39	1 37	1 34	1 33	1 32	1 33	30
31	4 26	3 51	3 25	3 6	2 49	2 36	2 26	2 10	1 58	1 50	1 44	1 40	1 37	1 34	1 33	1 32	1 32	31
32	4 33	3 57	3 30	3 11	2 53	2 40	2 29	2 13	2 0	1 52	1 46	1 41	1 38	1 35	1 34	1 33	1 32	32
33	4 40	4 3	3 36	3 15	2 58	2 44	2 32	2 16	2 2	1 53	1 47	1 42	1 38	1 35	1 34	1 33	1 32	33
34	4 48	4 10	3 42	3 19	3 2	2 47	2 35	2 18	2 4	1 55	1 48	1 43	1 39	1 36	1 34	1 33	1 32	34
35	4 55	4 16	3 47	3 24	3 6	2 51	2 39	2 20	2 6	1 57	1 50	1 44	1 40	1 36	1 34	1 33	1 32	35
36	5 2	4 22	3 52	3 28	3 10	2 55	2 42	2 22	2 9	1 59	1 51	1 45	1 41	1 37	1 35	1 34	1 33	36
37	5 9	4 27	3 57	3 33	3 14	2 59	2 45	2 25	2 11	2 1	1 53	1 46	1 42	1 38	1 35	1 34	1 33	37
38	5 16	4 33	4 2	3 38	3 18	3 2	2 49	2 28	2 13	2 2	1 54	1 47	1 43	1 39	1 36	1 34	1 33	38
39	5 23	4 39	4 7	3 42	3 22	3 6	2 53	2 30	2 15	2 4	1 56	1 49	1 44	1 40	1 36	1 35	1 34	39
40	5 30	4 45	4 12	3 46	3 26	3 9	2 57	2 32	2 17	2 6	1 57	1 50	1 45	1 41	1 37	1 35	1 34	40
41	5 37	4 51	4 17	3 50	3 30	3 13	3 0	2 34	2 20	2 8	1 58	1 51	1 46	1 42	1 38	1 35	1 34	41
42	5 44	4 56	4 22	3 54	3 33	3 16	3 3	2 37	2 22	2 10	2 0	1 52	1 47	1 43	1 39	1 36	1 35	42
43	5 50	5 2	4 27	3 59	3 37	3 19	3 7	2 39	2 24	2 12	2 1	1 54	1 48	1 44	1 40	1 37	1 35	43
44	5 56	5 7	4 32	4 3	3 41	3 23	3 10	2 43	2 26	2 14	2 3	1 55	1 49	1 45	1 40	1 37	1 36	44
46	6 8	5 17	4 41	4 11	3 48	3 30	3 15	2 47	2 30	2 17	2 6	1 57	1 51	1 46	1 40	1 38	1 37	46
48	6 20	5 27	4 50	4 19	3 55	3 36	3 20	2 52	2 34	2 20	2 9	2 0	1 53	1 47	1 43	1 40	1 38	48
50	6 32	5 37	4 58	4 26	4 2	3 42	3 26	2 57	2 37	2 23	2 12	2 2	1 55	1 49	1 45	1 41	1 39	50
52	6 42	5 46	5 7	4 33	4 9	3 48	3 32	3 1	2 41	2 26	2 14	2 4	1 57	1 51	1 46	1 42	1 40	52
54	6 53	5 55	5 15	4 40	4 15	3 54	3 37	3 5	2 45	2 29	2 17	2 7	1 59	1 52	1 47	1 43	1 40	54
56	7 3	6 4	5 22	4 47	4 21	3 59	3 41	3 9	2 49	2 33	2 20	2 10	2 1	1 54	1 48	1 44	1 41	56
58	7 12	6 12	5 29	4 53	4 27	4 4	3 45	3 13	2 52	2 36	2 23	2 12	2 3	1 55	1 49	1 45	1 42	58
60	7 21	6 20	5 36	4 59	4 32	4 8	3 51	3 17	2 55	2 39	2 25	2 14	2 4	1 56	1 51	1 46	1 43	60
62	7 30	6 27	5 42	5 4	4 36	4 13	3 56	3 21	2 58	2 41	2 27	2 16	2 6	1 58	1 52	1 47	1 43	62
64	7 38	6 34	5 48	5 9	4 41	4 17	4 0	3 24	3 1	2 43	2 29	2 18	2 8	2 0	1 53	1 48	1 44	64
66	7 45	6 40	5 54	5 14	4 45	4 21	4 4	3 27	3 3	2 45	2 31	2 19	2 9	2 0	1 54	1 50	1 45	66
68	7 51	6 45	5 59	5 18	4 49	4 25	4 7	3 30	3 6	2 47	2 33	2 21	2 10	2 2	1 55	1 50	1 46	68
70	7 57	6 50	6 3	5 22	4 53	4 28	4 10	3 32	3 8	2 49	2 34	2 22	2 11	2 2	1 55	1 50	1 46	70
72	8 3	6 55	6 7	5 26	4 56	4 31	4 13	3 35	3 10	2 50	2 35	2 23	2 12	2 3	1 56	1 52	1 47	72
74	8 8	6 59	6 10	5 30	4 59	4 33	4 16	3 37	3 11	2 51	2 36	2 24	2 13	2 4	1 57	1 52	1 47	74
76	8 12	7 3	6 14	5 33	5 2	4 35	4 20	3 38	3 13	2 52	2 37	2 24	2 14	2 4	1 58	1 52		76
78	8 16	7 7	6 17	5 36	5 4	4 37	4 22	3 40	3 14	2 53	2 38	2 25	2 15	2 5	1 58			78
80	8 19	7 10	6 19	5 38	5 6	4 34	4 24	3 41	3 15	2 54	2 39	2 26	2 16	2 6				80
82			6 21	5 40	5 8	4 41	4 26	3 42	3 15	2 55	2 40	2 26	2 16					82
84					5 10	4 42	4 28	3 43	3 16	2 56	2 40	2 26						84
86							4 30	3 43	3 17	2 56	2 40							86
	6°	7°	8°	9°	10°	11°	12°	14°										

APPARENT DISTANCE, 74°

Apparent Altitude of the Sun or Star.

34°	36°	38°	40°	42°	44°	46°	50°	54°	58°	62°	66°	70°	74°	78°	82°	86°	☾'s Alt.
′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	
4 41	4 56	5 10	5 26	5 36	5 50	6 1	6 25	6 46	7 5	7 24	7 41	7 52	8 5	8 13			6°
4 4	4 17	4 29	4 40	4 51	5 2	5 13	5 33	5 52	6 9	6 24	6 37	6 48	6 58	7 6			7
3 37	3 48	3 59	4 9	4 19	4 28	4 37	4 54	5 10	5 26	5 39	5 51	6 1	6 9	6 16	6 22		8
3 16	3 25	3 34	3 43	3 52	4 0	4 8	4 24	4 38	4 51	5 2	5 12	5 21	5 29	5 35	5 41		9
2 59	3 7	3 15	3 22	3 30	3 37	3 45	4 0	4 12	4 24	4 34	4 43	4 52	4 58	5 4	5 8		10
2 45	2 52	2 59	3 6	3 13	3 20	3 26	3 39	3 50	4 1	4 11	4 19	4 26	4 32	4 37	4 41		11
2 33	2 40	2 46	2 52	2 59	3 5	3 11	3 23	3 33	3 42	3 51	3 59	4 5	4 10	4 14	4 18	4 21	12
2 23	2 29	2 35	2 41	2 47	2 53	2 58	3 8	3 18	3 26	3 34	3 41	3 47	3 51	3 55	3 58	4 1	13
2 15	2 20	2 26	2 31	2 36	2 41	2 46	2 56	3 4	3 12	3 20	3 26	3 31	3 35	3 39	3 41	3 43	14
2 8	2 13	2 18	2 22	2 27	2 32	2 36	2 45	2 53	3 1	3 7	3 13	3 18	3 22	3 23	3 27	3 29	15
2 3	2 7	2 11	2 16	2 20	2 24	2 28	2 35	2 43	2 50	2 56	3 2	3 6	3 10	3 13	3 15	3 17	16
1 58	2 1	2 5	2 9	2 13	2 17	2 21	2 27	2 34	2 41	2 47	2 52	2 56	3 0	3 2	3 4	3 6	17
1 53	1 56	2 0	2 4	2 8	2 11	2 15	2 21	2 28	2 34	2 40	2 44	2 48	2 51	2 53	2 55	2 56	18
1 49	1 52	1 56	2 0	2 3	2 6	2 9	2 15	2 22	2 28	2 33	2 37	2 40	2 43	2 45	2 47	2 48	19
1 46	1 49	1 52	1 55	1 58	2 1	2 4	2 11	2 16	2 22	2 26	2 28	2 33	2 35	2 37	2 39	2 40	20
1 43	1 46	1 49	1 51	1 54	1 57	2 0	2 5	2 11	2 16	2 20	2 24	2 27	2 29	2 31	2 32		21
1 41	1 44	1 46	1 48	1 51	1 54	1 56	2 1	2 6	2 10	2 14	2 18	2 21	2 23	2 25	2 26		22
1 40	1 42	1 44	1 46	1 48	1 50	1 53	1 57	2 1	2 5	2 9	2 13	2 15	2 17	2 19	2 20		23
1 38	1 40	1 42	1 44	1 46	1 48	1 50	1 54	1 57	2 1	2 5	2 8	2 10	2 12	2 14	2 15		24
1 37	1 38	1 40	1 42	1 44	1 45	1 47	1 51	1 54	1 57	2 1	2 4	2 6	2 8	2 9			25
1 36	1 37	1 39	1 40	1 42	1 43	1 45	1 48	1 51	1 54	1 57	2 0	2 2	2 4	2 5			26
1 35	1 36	1 38	1 39	1 40	1 41	1 43	1 46	1 48	1 51	1 54	1 57	1 59	2 0	2 2			27
1 35	1 36	1 37	1 37	1 38	1 40	1 41	1 44	1 46	1 48	1 51	1 54	1 56	1 57	1 59			28
1 34	1 35	1 36	1 36	1 37	1 38	1 39	1 42	1 44	1 46	1 48	1 51	1 53	1 55				29
1 33	1 34	1 35	1 35	1 36	1 37	1 38	1 40	1 42	1 44	1 46	1 48	1 50	1 52				30
1 33	1 33	1 34	1 34	1 35	1 36	1 37	1 38	1 40	1 42	1 44	1 46	1 48	1 49				31
1 32	1 32	1 33	1 33	1 34	1 35	1 36	1 37	1 39	1 41	1 42	1 44	1 46	1 47				32
1 31	1 32	1 33	1 33	1 33	1 34	1 35	1 36	1 37	1 39	1 41	1 43	1 44					33
1 31	1 31	1 32	1 32	1 33	1 33	1 34	1 35	1 36	1 38	1 39	1 41	1 42					34
1 31	1 31	1 31	1 31	1 32	1 33	1 33	1 34	1 35	1 36	1 38	1 39	1 40					35
1 32	1 31	1 31	1 31	1 31	1 32	1 32	1 33	1 35	1 36	1 37	1 38	1 39					36
1 32	1 31	1 30	1 31	1 31	1 31	1 31	1 32	1 34	1 35	1 36	1 37						37
1 32	1 31	1 30	1 31	1 30	1 30	1 31	1 32	1 33	1 34	1 35	1 36						38
1 32	1 31	1 30	1 31	1 30	1 30	1 31	1 31	1 32	1 33	1 34	1 34						39
1 33	1 32	1 31	1 31	1 30	1 30	1 30	1 31	1 32	1 32	1 33	1 33						40
1 33	1 32	1 31	1 31	1 30	1 30	1 30	1 30	1 31	1 31	1 32							41
1 33	1 32	1 31	1 30	1 29	1 29	1 29	1 29	1 30	1 30	1 31							42
1 33	1 32	1 31	1 30	1 29	1 29	1 28	1 29	1 29	1 29	1 30							43
1 34	1 32	1 31	1 30	1 29	1 29	1 28	1 28	1 28	1 28	1 29							44
1 35	1 33	1 32	1 31	1 29	1 28	1 27	1 27	1 28	1 28								46
1 35	1 34	1 32	1 31	1 29	1 28	1 27	1 27	1 27	1 27								48
1 36	1 34	1 33	1 32	1 30	1 29	1 28	1 27	1 26									50
1 37	1 34	1 33	1 32	1 30	1 29	1 28	1 26	1 25									52
1 37	1 35	1 34	1 33	1 31	1 29	1 28	1 26										54
1 38	1 36	1 34	1 33	1 31	1 30	1 28	1 26										56
1 39	1 37	1 35	1 38	1 31	1 30	1 28											58
1 40	1 37	1 35	1 33	1 31	1 30	1 28											60
1 40	1 38	1 35	1 33	1 31	1 31												62
1 41	1 39	1 36	1 34	1 31													64
1 41	1 39	1 36	1 34														66
1 42	1 39	1 36															68
1 42	1 39																70
1 43																	72
																	74
																	76
																	78
																	80
																	82
																	84
																	86
34°	36°	38°	40°	42°	44°	46°	50°	54°	58°	62°	66°	70°	74°	78°	82°	86°	

TABLE 36.

APPARENT DISTANCE, 78°

Apparent Altitude of the Sun or Star.

☾'s Alt.	6°	7°	8°	9°	10°	11°	12°	14°	16°	18°	20°	22°	24°	26°	28°	30°	32°
	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″
6°	1 38	1 41	1 43	1 47	1 51	1 56	2 2	2 15	2 29	2 44	3 0	3 15	3 30	3 45	4 0	4 14	4 29
7	1 42	1 39	1 40	1 42	1 45	1 49	1 53	2 3	2 11	2 26	2 39	2 52	3 4	3 17	3 29	3 42	3 54
8	1 46	1 41	1 39	1 40	1 42	1 44	1 47	1 54	2 4	2 14	2 24	2 35	2 46	2 56	3 7	3 18	3 29
9	1 51	1 44	1 41	1 39	1 40	1 41	1 43	1 48	1 56	2 4	2 13	2 22	2 32	2 41	2 50	2 59	3 9
10	1 56	1 48	1 43	1 41	1 39	1 40	1 41	1 44	1 50	1 57	2 4	2 12	2 20	2 28	2 36	2 44	2 53
11	2 2	1 52	1 46	1 43	1 41	1 39	1 40	1 42	1 46	1 51	1 57	2 4	2 11	2 18	2 25	2 32	2 40
12	2 9	1 57	1 50	1 46	1 43	1 40	1 39	1 40	1 43	1 47	1 52	1 58	2 4	2 10	2 17	2 23	2 30
13	2 15	2 2	1 54	1 49	1 45	1 42	1 40	1 39	1 41	1 44	1 48	1 53	1 58	2 4	2 10	2 15	2 21
14	2 22	2 8	1 58	1 52	1 47	1 44	1 42	1 39	1 40	1 42	1 45	1 49	1 54	1 59	2 4	2 9	2 15
15	2 29	2 14	2 3	1 56	1 50	1 46	1 44	1 40	1 39	1 41	1 43	1 47	1 51	1 55	1 59	2 4	2 8
16	2 37	2 20	2 8	2 0	1 52	1 49	1 46	1 41	1 39	1 40	1 42	1 45	1 48	1 51	1 55	1 59	2 3
17	2 43	2 26	2 13	2 4	1 56	1 51	1 48	1 42	1 40	1 39	1 41	1 43	1 45	1 48	1 51	1 55	1 59
18	2 51	2 32	2 19	2 8	2 0	1 54	1 50	1 44	1 41	1 38	1 40	1 41	1 43	1 45	1 48	1 51	1 54
19	2 59	2 39	2 24	2 12	2 4	1 57	1 52	1 45	1 42	1 39	1 39	1 40	1 41	1 43	1 46	1 48	1 51
20	3 7	2 45	2 29	2 17	2 8	2 0	1 54	1 47	1 43	1 40	1 38	1 39	1 40	1 42	1 44	1 46	1 48
21	3 14	2 52	2 35	2 22	2 12	2 4	1 57	1 49	1 44	1 41	1 39	1 38	1 39	1 40	1 42	1 44	1 46
22	3 22	2 58	2 40	2 26	2 16	2 7	2 0	1 51	1 46	1 42	1 40	1 38	1 38	1 39	1 40	1 42	1 45
23	3 30	3 4	2 45	2 31	2 20	2 11	2 3	1 54	1 48	1 44	1 40	1 38	1 37	1 38	1 39	1 41	1 43
24	3 37	3 10	2 51	2 36	2 23	2 14	2 6	1 56	1 49	1 45	1 41	1 39	1 37	1 38	1 39	1 40	1 42
25	3 45	3 16	2 56	2 40	2 27	2 17	2 9	1 58	1 51	1 46	1 42	1 39	1 38	1 38	1 38	1 39	1 41
26	3 52	3 22	3 2	2 45	2 31	2 21	2 13	2 1	1 53	1 47	1 43	1 40	1 38	1 37	1 38	1 39	1 40
27	4 0	3 29	3 7	2 50	2 35	2 24	2 16	2 4	1 55	1 49	1 44	1 41	1 39	1 38	1 37	1 38	1 39
28	4 7	3 35	3 12	2 55	2 39	2 28	2 20	2 6	1 56	1 50	1 45	1 41	1 39	1 38	1 37	1 37	1 39
29	4 14	3 41	3 17	2 59	2 44	2 32	2 23	2 9	1 58	1 52	1 46	1 42	1 40	1 38	1 37	1 36	1 37
30	4 21	3 47	3 23	3 4	2 48	2 36	2 26	2 11	2 0	1 53	1 47	1 43	1 41	1 39	1 37	1 36	1 37
31	4 28	3 53	3 28	3 8	2 52	2 39	2 30	2 14	2 2	1 55	1 48	1 44	1 41	1 39	1 37	1 36	1 37
32	4 35	3 59	3 33	3 13	2 56	2 43	2 33	2 16	2 4	1 56	1 50	1 45	1 42	1 40	1 38	1 37	1 37
33	4 42	4 5	3 39	3 17	3 0	2 47	2 36	2 19	2 6	1 58	1 51	1 46	1 43	1 41	1 39	1 37	1 37
34	4 49	4 11	3 44	3 21	3 4	2 50	2 39	2 21	2 8	1 59	1 53	1 47	1 44	1 41	1 39	1 37	1 37
35	4 56	4 17	3 48	3 26	3 8	2 54	2 42	2 24	2 11	2 1	1 54	1 48	1 44	1 41	1 39	1 37	1 37
36	5 3	4 23	3 54	3 30	3 12	2 58	2 45	2 26	2 13	2 3	1 55	1 49	1 45	1 42	1 40	1 38	1 37
37	5 10	4 28	3 59	3 35	3 17	3 1	2 48	2 29	2 15	2 5	1 57	1 50	1 46	1 43	1 41	1 39	1 38
38	5 17	4 34	4 4	3 40	3 21	3 5	2 52	2 31	2 17	2 6	1 58	1 51	1 47	1 44	1 41	1 39	1 38
39	5 24	4 39	4 9	3 44	3 25	3 9	2 55	2 33	2 19	2 8	2 0	1 53	1 48	1 44	1 42	1 40	1 38
40	5 30	4 45	4 14	3 48	3 29	3 12	2 58	2 36	2 21	2 10	2 1	1 54	1 49	1 45	1 42	1 40	1 38
41	5 37	4 51	4 19	3 52	3 33	3 16	3 1	2 38	2 24	2 12	2 2	1 55	1 50	1 46	1 43	1 41	1 39
42	5 43	4 56	4 24	3 56	3 36	3 19	3 4	2 41	2 26	2 14	2 4	1 56	1 51	1 47	1 44	1 41	1 39
43	5 50	5 2	4 29	4 0	3 40	3 22	3 7	2 43	2 28	2 15	2 5	1 58	1 52	1 48	1 45	1 42	1 40
44	5 56	5 7	4 34	4 4	3 43	3 26	3 10	2 46	2 30	2 17	2 7	1 59	1 53	1 49	1 45	1 42	1 40
46	6 8	5 17	4 43	4 12	3 51	3 33	3 16	2 51	2 34	2 20	2 10	2 1	1 55	1 50	1 46	1 43	1 41
48	6 19	5 27	4 52	4 20	3 58	3 39	3 22	2 56	2 37	2 23	2 12	2 4	1 57	1 52	1 48	1 45	1 42
50	6 30	5 37	5 0	4 28	4 4	3 45	3 27	3 0	2 41	2 27	2 15	2 6	1 59	1 54	1 49	1 46	1 43
52	6 41	5 46	5 8	4 35	4 11	3 51	3 32	3 5	2 45	2 30	2 18	2 9	2 1	1 55	1 51	1 47	1 44
54	6 51	5 55	5 16	4 42	4 17	3 56	3 37	3 9	2 49	2 33	2 21	2 12	2 3	1 57	1 52	1 49	1 45
56	7 1	6 4	5 23	4 49	4 23	4 1	3 42	3 13	2 52	2 36	2 24	2 14	2 5	1 58	1 54	1 50	1 46
58	7 11	6 13	5 30	4 55	4 29	4 6	3 47	3 17	2 55	2 39	2 27	2 16	2 7	2 0	1 55	1 51	1 47
60	7 20	6 21	5 37	5 1	4 34	4 11	3 51	3 21	2 58	2 42	2 29	2 18	2 9	2 2	1 56	1 52	1 48
62	7 28	6 28	5 43	5 6	4 38	4 16	3 55	3 24	3 1	2 45	2 31	2 20	2 10	2 3	1 57	1 53	1 49
64	7 36	6 34	5 49	5 11	4 42	4 20	3 59	3 28	3 4	2 47	2 33	2 22	2 12	2 4	1 58	1 53	1 49
66	7 43	6 40	5 54	5 16	4 47	4 24	4 3	3 31	3 7	2 49	2 35	2 23	2 13	2 5	1 59	1 54	1 50
68	7 49	6 45	5 59	5 20	4 51	4 28	4 7	3 34	3 10	2 51	2 37	2 25	2 15	2 6	2 0	1 55	1 51
70	7 55	6 50	6 4	5 24	4 55	4 31	4 10	3 36	3 12	2 53	2 38	2 26	2 16	2 7	2 1	1 56	1 52
72	8 0	6 54	6 8	5 28	4 58	4 34	4 12	3 39	3 14	2 54	2 39	2 27	2 17	2 8	2 2	1 57	
74	8 5	6 58	6 11	5 31	5 1	4 36	4 14	3 41	3 15	2 55	2 40	2 28	2 18	2 9	2 2		
76	8 10	7 2	6 14	5 34	5 4	4 38	4 16	3 42	3 16	2 56	2 41	2 29	2 19	2 10			
78	8 14	7 6	6 17	5 36	5 6	4 40	4 18	3 43	3 17	2 57	2 42	2 29	2 19				
80	8 17	7 9	6 20	5 39	5 8	4 42	4 20	3 44	3 18	2 58	2 42	2 30					
82	8 19	7 11	6 22	5 41	5 10	4 43	4 21	3 45	3 19	2 59	2 43						
84	8 22	7 13	6 24	5 43	5 11	4 44	4 22	3 46	3 20	3 0							
86			6 26	5 45	5 12	4 45	4 23	3 47	3 21								
	6°	7°	8°	9°	10°	11°	12°	14°	16°	18°	20°	22°	24°	26°	28°	30°	32°

TABLE 36.

APPARENT DISTANCE, 78°

Apparent Altitude of the Sun or Star.

34°	36°	38°	40°	42°	44°	46°	50°	54°	58°	62°	66°	70°	74°	78°	82°	86°	☾'s Alt.
′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	
4 43	4 57	5 11	5 26	5 38	5 51	6 3	6 27	6 48	7 7	7 28	7 40	7 54	8 5	8 13	8 19		6°
4 6	4 18	4 29	4 41	4 52	5 3	5 13	5 34	5 53	6 10	6 25	6 38	6 49	6 58	7 5	7 12		7
3 39	3 50	4 0	4 10	4 21	4 31	4 40	4 57	5 13	5 27	5 40	5 52	6 2	6 10	6 17	6 22	6 26	8
3 19	3 28	3 37	3 46	3 54	4 2	4 10	4 26	4 40	4 52	5 4	5 14	5 23	5 30	5 36	5 41	5 45	9
3 1	3 10	3 18	3 25	3 33	3 40	3 48	4 2	4 15	4 26	4 37	4 46	4 54	5 0	5 5	5 9	5 12	10
2 47	2 55	3 2	3 9	3 16	3 23	3 29	3 42	3 53	4 4	4 14	4 22	4 29	4 34	4 39	4 43	4 46	11
2 36	2 43	2 49	2 56	3 2	3 8	3 14	3 25	3 36	3 45	3 54	4 2	4 8	4 13	4 17	4 20	4 23	12
2 27	2 33	2 39	2 44	2 50	2 55	3 1	3 11	3 21	3 30	3 38	3 45	3 50	3 55	3 59	4 2	4 4	13
2 20	2 25	2 30	2 35	2 40	2 45	2 50	3 0	3 8	3 16	3 24	3 30	3 35	3 39	3 43	3 45	3 47	14
2 13	2 18	2 22	2 26	2 31	2 35	2 40	2 49	2 57	3 5	3 11	3 17	3 22	3 26	3 29	3 31	3 33	15
2 7	2 11	2 15	2 19	2 23	2 27	2 31	2 39	2 47	2 54	3 0	3 6	3 10	3 14	3 17	3 19	3 21	16
2 1	2 5	2 9	2 13	2 17	2 21	2 24	2 31	2 38	2 45	2 51	2 56	3 0	3 4	3 6	3 8		17
1 57	2 0	2 4	2 7	2 11	2 14	2 18	2 25	2 32	2 38	2 44	2 48	2 52	2 55	2 57	2 59		18
1 53	1 56	2 0	2 3	2 6	2 9	2 13	2 19	2 26	2 32	2 37	2 41	2 44	2 47	2 49	2 51		19
1 50	1 53	1 56	1 59	2 2	2 6	2 8	2 14	2 20	2 26	2 30	2 34	2 37	2 40	2 42	2 43		20
1 48	1 59	1 53	1 55	1 58	2 1	2 4	2 9	2 15	2 20	2 24	2 28	2 31	2 34	2 35			21
1 46	1 48	1 50	1 52	1 55	1 57	2 0	2 5	2 10	2 15	2 19	2 22	2 25	2 28	2 29			22
1 44	1 46	1 48	1 50	1 52	1 54	1 57	2 1	2 6	2 10	2 14	2 17	2 20	2 22	2 24			23
1 43	1 44	1 46	1 48	1 50	1 52	1 54	1 58	2 2	2 6	2 10	2 13	2 15	2 17	2 19			24
1 42	1 43	1 45	1 46	1 48	1 49	1 51	1 55	1 58	2 2	2 6	2 9	2 11	2 13				25
1 41	1 42	1 43	1 45	1 46	1 47	1 49	1 52	1 55	1 59	2 2	2 5	2 7	2 9				26
1 40	1 41	1 43	1 44	1 44	1 46	1 47	1 50	1 53	1 56	1 59	2 2	2 4	2 5				27
1 39	1 40	1 41	1 42	1 43	1 44	1 45	1 48	1 51	1 53	1 56	1 59	2 1	2 2				28
1 38	1 39	1 40	1 41	1 42	1 43	1 44	1 46	1 49	1 51	1 53	1 56	1 58					29
1 37	1 38	1 39	1 40	1 40	1 41	1 42	1 45	1 47	1 49	1 51	1 53	1 55					30
1 37	1 37	1 38	1 39	1 39	1 40	1 41	1 43	1 45	1 47	1 49	1 51	1 53					31
1 36	1 36	1 37	1 38	1 38	1 39	1 40	1 42	1 44	1 46	1 47	1 49	1 51					32
1 36	1 36	1 37	1 38	1 38	1 39	1 39	1 41	1 43	1 45	1 46	1 48						33
1 36	1 36	1 37	1 38	1 38	1 39	1 39	1 40	1 42	1 44	1 45	1 46						34
1 36	1 36	1 36	1 37	1 37	1 38	1 38	1 39	1 41	1 42	1 43	1 44						35
1 36	1 36	1 36	1 36	1 36	1 37	1 37	1 38	1 40	1 41	1 42	1 43						36
1 37	1 36	1 35	1 35	1 36	1 36	1 36	1 37	1 39	1 40	1 41							37
1 37	1 36	1 35	1 34	1 35	1 36	1 36	1 37	1 38	1 39	1 40							38
1 37	1 36	1 35	1 34	1 35	1 36	1 36	1 36	1 37	1 38	1 39							39
1 37	1 36	1 35	1 34	1 35	1 35	1 35	1 36	1 37	1 37	1 38							40
1 38	1 37	1 36	1 35	1 35	1 35	1 35	1 35	1 36	1 36								41
1 38	1 37	1 36	1 35	1 34	1 34	1 34	1 34	1 35	1 35								42
1 38	1 37	1 36	1 35	1 34	1 34	1 33	1 34	1 34	1 35								43
1 39	1 37	1 36	1 35	1 34	1 34	1 33	1 33	1 34	1 34								44
1 39	1 38	1 37	1 36	1 35	1 34	1 33	1 32	1 33									46
1 40	1 38	1 37	1 36	1 35	1 34	1 33	1 32	1 32									48
1 41	1 39	1 38	1 37	1 35	1 34	1 33	1 32										50
1 42	1 40	1 38	1 37	1 35	1 34	1 33	1 32										52
1 43	1 41	1 39	1 37	1 35	1 34	1 33											54
1 44	1 41	1 39	1 37	1 35	1 34	1 33											56
1 44	1 42	1 39	1 37	1 35	1 34												58
1 45	1 42	1 40	1 38	1 35													60
1 46	1 43	1 40	1 38														62
1 46	1 43	1 40															64
1 46	1 43																66
1 47																	68
																	70
																	72
																	74
																	76
																	78
																	80
																	82
																	84
																	86

TABLE 36.

APPARENT DISTANCE, 82°

Apparent Altitude of the Sun or Star.

☾'s Alt.	6°	7°	8°	9°	10°	11°	12°	14°	16°	18°	20°	22°	24°	26°	28°	30°	32°
	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″
6	1 43	1 46	1 48	1 52	1 56	2 1	2 7	2 18	2 34	2 48	3 3	3 18	3 33	3 46	4 2	4 17	4 31
7	1 47	1 43	1 45	1 47	1 50	1 53	1 57	2 7	2 18	2 31	2 43	2 55	3 8	3 21	3 33	3 46	3 58
8	1 50	1 46	1 43	1 45	1 47	1 49	1 52	1 59	2 8	2 18	2 28	2 39	2 50	3 1	3 12	3 22	3 33
9	1 54	1 49	1 46	1 43	1 45	1 47	1 50	1 54	2 1	2 9	2 18	2 27	2 36	2 45	2 55	3 4	3 13
10	1 59	1 52	1 48	1 46	1 43	1 45	1 47	1 50	1 56	2 2	2 9	2 17	2 24	2 32	2 41	2 49	2 57
11	2 5	1 56	1 51	1 48	1 46	1 43	1 45	1 48	1 52	1 56	2 2	2 9	2 15	2 23	2 30	2 37	2 45
12	2 11	2 1	1 54	1 50	1 48	1 45	1 43	1 46	1 49	1 52	1 56	2 2	2 8	2 15	2 22	2 28	2 35
13	2 18	2 6	1 58	1 53	1 50	1 47	1 45	1 45	1 47	1 49	1 53	1 58	2 3	2 8	2 14	2 20	2 26
14	2 25	2 12	2 2	1 56	1 52	1 49	1 46	1 43	1 45	1 47	1 50	1 54	1 59	2 4	2 9	2 14	2 20
15	2 32	2 16	2 7	2 1	1 55	1 51	1 48	1 45	1 44	1 46	1 48	1 51	1 55	2 0	2 4	2 9	2 14
16	2 38	2 24	2 12	2 4	1 59	1 54	1 50	1 46	1 43	1 45	1 47	1 49	1 52	1 55	2 0	2 4	2 8
17	2 47	2 30	2 17	2 8	2 1	1 56	1 52	1 47	1 45	1 44	1 45	1 47	1 50	1 53	1 57	2 0	2 4
18	2 55	2 36	2 23	2 13	2 5	1 59	1 54	1 49	1 46	1 43	1 44	1 46	1 48	1 51	1 54	1 57	2 0
19	3 2	2 42	2 28	2 17	2 9	2 2	1 56	1 50	1 47	1 44	1 43	1 45	1 46	1 49	1 51	1 54	1 57
20	3 10	2 48	2 33	2 22	2 12	2 5	1 59	1 52	1 48	1 45	1 43	1 44	1 45	1 47	1 49	1 52	1 54
21	3 17	2 55	2 39	2 26	2 16	2 8	2 2	1 54	1 49	1 46	1 44	1 43	1 44	1 45	1 47	1 49	1 51
22	3 25	3 3	2 45	2 31	2 20	2 11	2 5	1 56	1 51	1 47	1 44	1 43	1 43	1 44	1 46	1 47	1 49
23	3 33	3 7	2 49	2 35	2 24	2 15	2 8	1 59	1 53	1 49	1 45	1 43	1 43	1 44	1 45	1 46	1 48
24	3 40	3 13	2 55	2 40	2 27	2 18	2 11	2 1	1 54	1 50	1 46	1 43	1 43	1 43	1 44	1 45	1 47
25	3 47	3 19	3 0	2 44	2 31	2 22	2 14	2 3	1 56	1 51	1 47	1 44	1 43	1 43	1 44	1 44	1 46
26	3 54	3 25	3 6	2 49	2 35	2 25	2 17	2 5	1 57	1 52	1 48	1 45	1 44	1 43	1 43	1 43	1 45
27	4 2	3 32	3 11	2 54	2 39	2 29	2 21	2 8	1 59	1 53	1 49	1 46	1 44	1 43	1 42	1 43	1 44
28	4 9	3 38	3 16	2 58	2 43	2 32	2 24	2 10	2 1	1 55	1 50	1 46	1 44	1 43	1 42	1 43	1 43
29	4 17	3 45	3 22	3 3	2 48	2 36	2 28	2 13	2 3	1 57	1 51	1 47	1 45	1 43	1 42	1 42	1 43
30	24	3 51	3 27	3 7	2 52	2 40	2 31	2 16	2 5	1 58	1 52	1 48	1 46	1 44	1 43	1 42	1 42
31	31	3 57	3 32	3 12	2 56	2 43	2 34	2 19	2 7	2 0	1 54	1 49	1 46	1 44	1 43	1 42	1 42
32	38	4 3	3 37	3 16	3 0	2 47	2 37	2 21	2 9	2 1	1 55	1 50	1 47	1 45	1 43	1 42	1 42
33	45	4 9	3 42	3 21	3 4	2 51	2 40	2 24	2 11	2 3	1 56	1 51	1 48	1 46	1 44	1 42	1 42
34	51	4 14	3 47	3 25	3 8	2 54	2 43	2 26	2 13	2 4	1 58	1 52	1 49	1 46	1 44	1 43	1 42
35	58	4 20	3 52	3 30	3 12	2 58	2 46	2 29	2 16	2 6	1 59	1 53	1 49	1 46	1 44	1 43	1 42
36	5	4 26	3 57	3 34	3 16	3 2	2 49	2 31	2 18	2 8	2 0	1 55	1 50	1 47	1 45	1 43	1 43
37	3	4 31	4 2	3 39	3 21	3 5	2 53	2 34	2 20	2 10	2 2	1 56	1 51	1 48	1 46	1 44	1 43
38	9	4 37	4 7	3 44	3 25	3 9	2 56	2 36	2 22	2 11	2 3	1 57	1 52	1 48	1 46	1 44	1 43
39	6	4 43	4 12	3 48	3 29	3 13	3 0	2 39	2 25	2 13	2 4	1 58	1 53	1 49	1 47	1 45	1 43
40		4 49	4 17	3 52	3 33	3 16	3 3	2 41	2 26	2 15	2 6	2 0	1 54	1 49	1 47	1 45	1 43
41		4 54	4 22	3 56	3 37	3 20	3 6	2 44	2 28	2 17	2 8	2 1	1 55	1 50	1 48	1 46	1 44
42		4 59	4 27	4 0	3 40	3 23	3 9	2 46	2 30	2 18	2 9	2 2	1 56	1 51	1 48	1 46	1 45
43		5 5	4 32	4 4	3 44	3 27	3 12	2 49	2 32	2 20	2 10	2 4	1 57	1 52	1 49	1 47	1 46
44		5 10	4 37	4 8	3 48	3 31	3 15	2 51	2 34	2 22	2 12	2 5	1 58	1 53	1 50	1 48	1 46
46		5 20	4 46	4 16	3 55	3 37	3 21	2 56	2 38	2 26	2 15	2 7	2 0	1 55	1 52	1 49	1 47
48		5 30	4 55	4 24	4 4	3 43	3 27	3 1	2 42	2 29	2 18	2 9	2 2	1 57	1 53	1 50	1 48
50		5 40	5 3	4 32	4 8	3 49	3 32	3 6	2 46	2 32	2 21	2 12	2 5	1 59	1 55	1 51	1 49
52		5 49	5 11	4 39	4 14	3 55	3 37	3 10	2 50	2 35	2 24	2 15	2 7	2 1	1 57	1 53	1 50
54		5 58	5 19	4 46	4 20	4 1	3 42	3 14	2 54	2 38	2 27	2 17	2 9	2 2	1 58	1 55	1 51
56		7	5 26	4 52	4 26	4 6	3 47	3 18	2 57	2 41	2 29	2 19	2 11	2 4	2 0	1 56	1 52
58		15	5 33	4 58	4 32	4 11	3 52	3 22	3 0	2 44	2 32	2 21	2 13	2 6	2 1	1 57	1 53
60		23	5 40	5 4	4 37	4 16	3 56	3 26	3 3	2 47	2 34	2 23	2 14	2 7	2 2	1 58	1 54
62		30	5 46	5 9	4 42	4 20	4 0	3 30	3 6	2 50	2 36	2 25	2 16	2 9	2 3	1 59	1 55
64		37	5 52	5 14	4 46	4 24	4 4	3 33	3 9	2 52	2 38	2 26	2 17	2 10	2 4	1 59	1 55
66		43	5 57	5 19	4 51	4 28	4 8	3 36	3 12	2 54	2 40	2 28	2 19	2 11	2 5	2 0	1 56
68		8	6 2	5 23	4 55	4 32	4 12	3 39	3 15	2 56	2 42	2 30	2 20	2 12	2 6	2 1	
70		2	6 7	5 27	4 59	4 36	4 15	3 41	3 17	2 58	2 43	2 31	2 22	2 13	2 7		
72		5	6 11	5 31	5 3	4 39	4 17	3 43	3 19	3 0	2 44	2 32	2 23	2 14			
74			6 15	5 34	5 6	4 41	4 19	3 45	3 21	3 1	2 45	2 33	2 24				
76			6 18	5 36	5 8	4 43	4 21	3 47	3 22	3 2	2 46	2 34					
78			6 21	5 39	5 10	4 45	4 22	3 48	3 23	3 3	2 47						
80			6 23	5 42	5 12	4 47	4 24	3 49	3 24	3 4							
82			6 25	5 44	5 14	4 48	4 25	3 50	3 25								
84			6 27	5 46	5 15	4 49	4 26	3 51									
86			6 29	5 48	5 16	4 50	4 27										
			8°	9°	10°	11°	12°	14°	16°	18°	20°	22°	24°	26°	28°	30°	32°

TABLE 36.

APPARENT DISTANCE, 82°

Apparent Altitude of the Sun or Star.

34°	36°	38°	40°	42°	44°	46°	50°	54°	58°	62°	66°	70°	74°	78°	82°	86°	☽'s
′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	Alt.
4 46	5 0	5 13	5 26	5 40	5 52	6 5	6 27	6 49	7 9	7 27	7 42	7 55	8 6	8 14	8 20	8 25	6°
4 10	4 21	4 33	4 44	4 55	5 5	5 16	5 37	5 56	6 13	6 28	6 40	6 51	7 0	7 7	7 13	7 17	7
3 44	3 54	4 4	4 14	4 25	4 34	4 44	5 1	5 17	5 31	5 44	5 56	6 6	6 14	6 20	6 25	6 29	8
3 23	3 32	3 41	3 49	3 58	4 6	4 14	4 30	4 44	5 56	5 7	5 17	5 26	5 34	5 40	5 45	5 48	9
3 6	3 14	3 22	3 30	3 38	3 45	3 52	4 6	4 18	4 30	4 41	4 50	4 58	5 4	5 10	5 14	5 16	10
2 52	3 0	3 7	3 14	3 21	3 28	3 34	3 47	3 59	4 9	4 18	4 27	4 34	4 39	4 44	4 48	4 50	11
2 41	2 48	2 55	3 1	3 7	3 13	3 19	3 31	3 41	3 51	3 59	4 7	4 13	4 18	4 22	4 25	4 27	12
2 22	2 38	2 44	2 49	2 55	3 0	3 6	3 17	3 26	3 35	3 42	3 49	3 55	4 0	4 4	4 6		13
2 25	2 30	2 35	2 41	2 45	2 50	2 55	3 5	3 13	3 21	3 28	3 34	3 40	3 44	3 48	3 50		14
2 18	2 23	2 27	2 31	2 36	2 40	2 45	2 54	3 2	3 9	3 16	3 22	3 27	3 31	3 34	3 37		15
2 12	2 17	2 21	2 25	2 29	2 33	2 37	2 44	2 53	2 59	3 5	3 10	3 16	3 20	3 23	3 25		16
2 7	2 11	2 15	2 19	2 23	2 26	2 30	2 37	2 44	2 50	2 56	3 1	3 6	3 9	3 12			17
2 3	2 6	2 10	2 13	2 17	2 20	2 24	2 31	2 37	2 43	2 49	2 53	2 57	3 0	3 3			18
1 59	2 2	2 5	2 8	2 12	2 15	2 19	2 25	2 31	2 37	2 42	2 46	2 50	2 53	2 55			19
1 56	1 59	2 1	2 5	2 8	2 11	2 14	2 20	2 25	2 31	2 35	2 39	2 42	2 45	2 47			20
1 54	1 56	1 58	2 1	2 4	2 7	2 10	2 15	2 20	2 25	2 30	2 33	2 36	2 39				21
1 51	1 53	1 56	1 58	2 1	2 4	2 6	2 11	2 16	2 20	2 24	2 28	2 31	2 33				22
1 49	1 51	1 53	1 55	1 58	2 0	2 2	2 7	2 12	2 16	2 20	2 23	2 26	2 29				23
1 48	1 49	1 51	1 53	1 55	1 57	1 59	2 4	2 8	2 12	2 16	2 19	2 22	2 24				24
1 47	1 48	1 50	1 51	1 53	1 55	1 57	2 1	2 4	2 8	2 12	2 15	2 17					25
1 46	1 47	1 48	1 50	1 51	1 53	1 55	1 58	2 1	2 5	2 8	2 11	2 13					26
1 45	1 46	1 47	1 48	1 50	1 51	1 53	1 56	1 59	2 3	2 5	2 8	2 10					27
1 44	1 45	1 46	1 47	1 48	1 49	1 51	1 54	1 57	2 0	2 2	2 5	2 7					28
1 44	1 44	1 45	1 46	1 47	1 48	1 49	1 52	1 55	1 58	2 0	2 2						29
1 43	1 43	1 44	1 45	1 46	1 47	1 48	1 51	1 54	1 56	1 58	2 0						30
1 43	1 43	1 44	1 45	1 45	1 46	1 47	1 50	1 52	1 54	1 56	1 58						31
1 42	1 42	1 43	1 44	1 44	1 45	1 46	1 48	1 50	1 52	1 54	1 56						32
1 42	1 42	1 43	1 43	1 44	1 44	1 45	1 47	1 49	1 51	1 52							33
1 41	1 41	1 42	1 42	1 43	1 44	1 45	1 46	1 48	1 50	1 51							34
1 41	1 41	1 42	1 42	1 43	1 43	1 44	1 45	1 47	1 48	1 49							35
1 42	1 41	1 41	1 42	1 42	1 42	1 43	1 45	1 46	1 47	1 47							36
1 42	1 41	1 41	1 42	1 42	1 42	1 42	1 44	1 45	1 46								37
1 42	1 41	1 41	1 41	1 41	1 41	1 42	1 43	1 44	1 45								38
1 42	1 41	1 41	1 41	1 41	1 41	1 41	1 42	1 43	1 44								39
1 42	1 42	1 41	1 41	1 41	1 41	1 41	1 42	1 42	1 42								40
1 43	1 42	1 42	1 41	1 41	1 41	1 41	1 41	1 41									41
1 44	1 43	1 42	1 41	1 40	1 40	1 40	1 40	1 41									42
1 44	1 43	1 42	1 41	1 40	1 40	1 40	1 40	1 40									43
1 45	1 43	1 42	1 41	1 40	1 40	1 40	1 39										44
1 45	1 44	1 42	1 41	1 40	1 40	1 40	1 39										46
1 46	1 44	1 43	1 42	1 41	1 40	1 40	1 39										48
1 47	1 45	1 44	1 42	1 41	1 40	1 39											50
1 48	1 46	1 44	1 42	1 41	1 40	1 39											52
1 49	1 46	1 44	1 42	1 41	1 40												54
1 50	1 47	1 45	1 43	1 41													56
1 50	1 47	1 45	1 43														58
1 51	1 48	1 45															60
1 51	1 48																62
1 52																	64
																	66
																	68
																	70
																	72
																	74
																	76
																	78
																	80
																	82
																	84
																	86
34°	36°	38°	40°	42°	44°	46°	50°	54°	58°	62°	66°	70°	74°	78°	82°	86°	

TABLE 36.

APPARENT DISTANCE, 86°

Apparent Altitude of the Sun or Star.

☾'s Alt.	6°	7°	8°	9°	10°	11°	12°	14°	16°	18°	20°	22°	24°	26°	28°	30°	32°	☽'s Alt.
	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	
6°	1 50	1 51	1 53	1 56	2 1	2 7	2 12	2 25	2 39	2 53	3 8	3 23	3 38	3 53	4 8	4 22	4 37	6°
7	1 52	1 50	1 51	1 53	1 56	1 59	2 3	2 13	2 24	2 36	2 48	3 0	3 13	3 25	3 37	3 50	4 2	7
8	1 55	1 52	1 50	1 51	1 53	1 55	1 58	2 5	2 14	2 24	2 34	2 45	2 56	3 6	3 16	3 27	3 38	8
9	1 59	1 55	1 52	1 50	1 51	1 53	1 55	2 0	2 7	2 15	2 23	2 32	2 42	2 51	3 0	3 9	3 19	9
10	2 4	1 58	1 54	1 52	1 50	1 51	1 53	1 56	2 2	2 8	2 15	2 22	2 30	2 39	2 47	2 55	3 3	10
11	2 10	2 2	1 57	1 54	1 52	1 50	1 51	1 54	1 58	2 2	2 8	2 15	2 21	2 29	2 36	2 44	2 51	11
12	2 16	2 7	2 0	1 56	1 54	1 51	1 50	1 52	1 55	1 58	2 3	2 8	2 14	2 21	2 27	2 34	2 41	12
13	2 23	2 12	2 4	1 59	1 56	1 53	1 51	1 51	1 53	1 55	1 59	2 3	2 9	2 14	2 20	2 26	2 32	13
14	2 30	2 17	2 8	2 2	1 58	1 55	1 53	1 50	1 51	1 53	1 56	2 0	2 4	2 9	2 14	2 19	2 24	14
15	2 37	2 23	2 13	2 6	2 1	1 57	1 54	1 51	1 50	1 52	1 54	1 57	2 1	2 5	2 10	2 14	2 19	15
16	2 44	2 29	2 17	2 10	2 4	1 59	1 56	1 52	1 50	1 51	1 53	1 55	1 58	2 2	2 6	2 10	2 14	16
17	2 51	2 34	2 22	2 14	2 7	2 2	1 58	1 53	1 50	1 50	1 51	1 53	1 56	1 59	2 3	2 6	2 9	17
18	2 59	2 40	2 27	2 18	2 10	2 4	2 0	1 55	1 51	1 49	1 50	1 52	1 54	1 57	1 59	2 2	2 5	18
19	3 7	2 46	2 33	2 22	2 14	2 7	2 2	1 56	1 52	1 50	1 49	1 51	1 52	1 55	1 57	2 0	2 2	19
20	3 14	2 52	2 38	2 27	2 17	2 10	2 5	1 58	1 53	1 51	1 49	1 50	1 51	1 53	1 55	1 58	2 0	20
21	3 22	2 59	2 44	2 31	2 21	2 14	2 8	2 0	1 55	1 52	1 50	1 49	1 50	1 51	1 53	1 55	1 57	21
22	3 29	3 5	2 49	2 36	2 25	2 17	2 11	2 2	1 56	1 53	1 50	1 49	1 49	1 50	1 52	1 53	1 55	22
23	3 37	3 12	2 54	2 40	2 29	2 21	2 14	2 4	1 58	1 54	1 51	1 50	1 49	1 50	1 51	1 52	1 53	23
24	3 44	3 18	2 59	2 45	2 33	2 24	2 17	2 6	1 59	1 55	1 52	1 50	1 49	1 49	1 50	1 51	1 52	24
25	3 52	3 24	3 5	2 49	2 37	2 28	2 20	2 8	2 1	1 57	1 53	1 50	1 49	1 49	1 49	1 50	1 51	25
26	3 59	3 30	3 10	2 54	2 41	2 31	2 23	2 11	2 3	1 58	1 54	1 51	1 50	1 49	1 49	1 49	1 50	26
27	4 7	3 36	3 15	2 59	2 45	2 35	2 27	2 14	2 5	1 59	1 55	1 52	1 50	1 49	1 48	1 49	1 50	27
28	4 14	3 42	3 20	3 3	2 49	2 38	2 30	2 16	2 7	2 1	1 56	1 52	1 50	1 49	1 48	1 48	1 49	28
29	4 21	3 49	3 26	3 8	2 53	2 42	2 33	2 19	2 9	2 2	1 57	1 53	1 50	1 49	1 48	1 48	1 49	29
30	4 28	3 55	3 32	3 12	2 57	2 46	2 36	2 21	2 11	2 3	1 58	1 54	1 51	1 50	1 49	1 48	1 48	30
31	4 36	4 1	3 37	3 17	3 1	2 49	2 39	2 24	2 13	2 5	1 59	1 55	1 52	1 50	1 49	1 48	1 48	31
32	4 43	4 7	3 42	3 22	3 5	2 53	2 42	2 26	2 15	2 6	2 0	1 56	1 53	1 51	1 49	1 48	1 48	32
33	4 50	4 13	3 48	3 26	3 9	2 57	2 46	2 29	2 17	2 8	2 2	1 57	1 53	1 51	1 49	1 49	1 48	33
34	4 57	4 18	3 53	3 31	3 14	3 0	2 49	2 31	2 19	2 10	2 3	1 58	1 54	1 51	1 50	1 49	1 48	34
35	5 4	4 24	3 58	3 35	3 10	3 4	2 52	2 34	2 21	2 12	2 5	1 59	1 55	1 52	1 50	1 49	1 48	35
36	5 10	4 30	4 3	3 40	3 22	3 8	2 55	2 37	2 23	2 13	2 6	2 1	1 56	1 52	1 50	1 49	1 49	36
37	5 17	4 36	4 8	3 45	3 26	3 11	2 59	2 40	2 25	2 15	2 7	2 2	1 57	1 53	1 51	1 50	1 49	37
38	5 24	4 42	4 13	3 49	3 30	3 15	3 2	2 42	2 28	2 17	2 9	2 3	1 58	1 54	1 52	1 50	1 49	38
39	5 31	4 48	4 18	3 54	3 34	3 18	3 5	2 45	2 31	2 19	2 10	2 4	1 59	1 55	1 52	1 51	1 50	39
40	5 37	4 53	4 23	3 58	3 38	3 22	3 8	2 48	2 32	2 21	2 12	2 6	2 0	1 55	1 53	1 51	1 50	40
41	5 44	4 59	4 28	4 2	3 42	3 26	3 11	2 50	2 34	2 23	2 14	2 7	2 1	1 56	1 53	1 51	1 50	41
42	5 50	5 4	4 33	4 6	3 46	3 29	3 14	2 52	2 36	2 24	2 15	2 8	2 2	1 57	1 54	1 52	1 51	42
43	5 56	5 10	4 38	4 10	3 50	3 33	3 17	2 55	2 38	2 26	2 16	2 9	2 3	1 58	1 55	1 53	1 52	43
44	6 3	5 15	4 43	4 14	3 53	3 36	3 20	2 57	2 40	2 28	2 18	2 10	2 4	1 59	1 56	1 54	1 52	44
46	6 15	5 25	4 52	4 22	4 0	3 43	3 26	3 2	2 44	2 32	2 21	2 13	2 6	2 1	1 58	1 55	1 53	46
48	6 26	5 35	5 1	4 30	4 7	3 49	3 32	3 7	2 48	2 35	2 24	2 15	2 8	2 3	1 59	1 56	1 54	48
50	6 37	5 45	5 9	4 38	4 14	3 55	3 38	3 12	2 52	2 38	2 27	2 18	2 10	2 5	2 1	1 58	1 56	50
52	6 48	5 54	5 17	4 45	4 20	4 0	3 43	3 16	2 56	2 41	2 30	2 21	2 13	2 7	2 3	2 0	1 57	52
54	6 58	6 3	5 25	4 52	4 26	4 6	3 48	3 20	3 0	2 44	2 33	2 23	2 15	2 9	2 5	2 1	1 58	54
56	7 7	6 12	5 32	4 58	4 32	4 11	3 53	3 24	3 4	2 47	2 35	2 25	2 17	2 11	2 6	2 2	1 59	56
58	7 16	6 20	5 39	5 4	4 37	4 16	3 58	3 28	3 7	2 50	2 38	2 27	2 19	2 12	2 7	2 3	1 59	58
60	7 25	6 28	5 45	5 9	4 42	4 21	4 2	3 32	3 10	2 53	2 40	2 29	2 20	2 13	2 8	2 4	2 0	60
62	7 33	6 35	5 51	5 14	4 47	4 26	4 6	3 35	3 13	2 56	2 42	2 31	2 22	2 15	2 10	2 5	2 1	62
64	7 41	6 42	5 57	5 19	4 52	4 30	4 9	3 39	3 16	2 59	2 44	2 33	2 24	2 16	2 11	2 6		64
66	7 48	6 48	6 2	5 24	4 57	4 34	4 14	3 42	3 19	3 1	2 46	2 35	2 26	2 18	2 12			66
68	7 54	6 53	6 7	5 28	5 1	4 38	4 18	3 44	3 22	3 3	2 48	2 36	2 27	2 19				68
70	8 0	6 57	6 12	5 32	5 5	4 41	4 20	3 47	3 24	3 5	2 49	2 37	2 28					70
72	8 6	7 1	6 16	5 36	5 8	4 44	4 23	3 49	3 26	3 6	2 50	2 38						72
74	8 9	7 5	6 20	5 39	5 11	4 46	4 25	3 51	3 27	3 7	2 51							74
76	8 14	7 9	6 23	5 42	5 14	4 48	4 27	3 53	3 28	3 8								76
78	8 18	7 12	6 26	5 45	5 16	4 50	4 28	3 54	3 29									78
80	8 21	7 15	6 28	5 48	5 18	4 52	4 30	3 55										80
82	8 24	7 18	6 30	5 50	5 20	4 54	4 31											82
84	8 27	7 20	6 32	5 52	5 21													84
86	8 29	7 22	6 34															86
	6°	7°	8°	9°	10°	11°	12°	14°	16°	18°	20°	22°	24°	26°	28°	30°	32°	

TABLE 36.

Apparent Distance, 86°

Apparent Altitude of the Sun or Star.

34°	36°	38°	40°	42°	44°	46°	50°	54°	58°	62°	66°	70°	74°	78°	82°	86°	☾'s Alt.
′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	
4 51	5 5	5 18	5 31	5 44	5 56	6 9	6 32	6 54	7 13	7 30	7 45	7 58	8 9	8 17	8 24	8 29	6°
4 14	4 26	4 38	4 49	5 0	5 11	5 22	5 42	6 1	6 18	6 33	6 45	6 56	7 5	7 12	7 18	7 23	7
3 49	4 0	4 10	4 20	4 30	4 39	4 49	5 7	5 23	5 37	5 49	6 1	6 12	6 20	6 26	6 31	6 34	8
3 28	3 37	3 46	3 55	4 4	4 12	4 20	4 36	4 50	5 2	5 13	5 23	5 32	5 39	5 45	5 50		9
3 11	3 19	3 27	3 35	3 43	3 50	3 58	4 12	4 24	4 35	4 46	4 55	5 4	5 10	5 16	5 20		10
2 58	3 6	3 13	3 20	3 27	3 33	3 40	3 53	4 4	4 14	4 24	4 33	4 40	4 46	4 50	4 54		11
2 47	2 54	3 1	3 7	3 13	3 19	3 25	3 37	3 47	3 57	4 5	4 13	4 19	4 25	4 29	4 32		12
2 38	2 44	2 50	2 55	3 1	3 7	3 12	3 23	3 32	3 41	3 48	3 55	4 1	4 6	4 10			13
2 30	2 35	2 41	2 46	2 51	2 56	3 1	3 11	3 19	3 27	3 34	3 40	3 46	3 50	3 54			14
2 24	2 29	2 33	2 37	2 42	2 46	2 51	3 0	3 8	3 15	3 22	3 28	3 33	3 37	3 40			15
2 18	2 23	2 27	2 31	2 35	2 39	2 43	2 51	2 59	3 5	3 12	3 18	3 22	3 26	3 29			16
2 13	2 17	2 21	2 25	2 29	2 33	2 37	2 44	2 51	2 57	3 3	3 8	3 12	3 16				17
2 9	2 13	2 16	2 20	2 24	2 27	2 31	2 37	2 43	2 49	2 55	3 0	3 4	3 7				18
2 5	2 9	2 12	2 15	2 19	2 23	2 26	2 32	2 37	2 43	2 48	2 52	2 56	2 59				19
2 3	2 5	2 8	2 11	2 15	2 18	2 21	2 27	2 32	2 37	2 42	2 45	2 48	2 51				20
2 0	2 2	2 5	2 8	2 11	2 13	2 16	2 22	2 27	2 32	2 36	2 39	2 42					21
1 57	1 59	2 2	2 5	2 7	2 9	2 12	2 17	2 22	2 27	2 31	2 34	2 37					22
1 55	1 57	1 58	2 1	2 4	2 6	2 8	2 13	2 18	2 22	2 26	2 29	2 32					23
1 53	1 55	1 57	1 59	2 1	2 3	2 5	2 10	2 14	2 18	2 22	2 25	2 28					24
1 52	1 53	1 55	1 57	1 59	2 1	2 3	2 7	2 11	2 15	2 18	2 21						25
1 51	1 52	1 54	1 55	1 57	2 0	2 2	2 5	2 8	2 12	2 15	2 18						26
1 51	1 52	1 53	1 54	1 56	1 59	2 0	2 3	2 6	2 9	2 12	2 14						27
1 50	1 51	1 52	1 53	1 54	1 57	1 59	2 1	2 4	2 7	2 9	2 12						28
1 50	1 50	1 51	1 52	1 53	1 56	1 58	1 59	2 2	2 4	2 7							29
1 49	1 49	1 50	1 51	1 52	1 55	1 57	1 58	2 0	2 3	2 5							30
1 48	1 49	1 50	1 51	1 52	1 54	1 56	1 57	1 59	2 1	2 2							31
1 48	1 48	1 49	1 50	1 51	1 53	1 55	1 55	1 57	1 59	2 0							32
1 48	1 48	1 49	1 49	1 50	1 52	1 54	1 54	1 56	1 57								33
1 47	1 47	1 48	1 48	1 49	1 51	1 53	1 53	1 55	1 56								34
1 47	1 47	1 48	1 48	1 49	1 50	1 51	1 52	1 53	1 54								35
1 48	1 47	1 47	1 47	1 48	1 48	1 49	1 51	1 52	1 53								36
1 48	1 47	1 47	1 47	1 48	1 48	1 48	1 50	1 51									37
1 48	1 47	1 47	1 47	1 47	1 47	1 48	1 49	1 50									38
1 48	1 47	1 47	1 47	1 47	1 47	1 48	1 48	1 49									39
1 49	1 48	1 48	1 48	1 47	1 47	1 47	1 48	1 48									40
1 49	1 48	1 48	1 48	1 47	1 47	1 47	1 47										41
50	1 49	1 48	1 48	1 47	1 47	1 47	1 47										42
51	1 49	1 48	1 48	1 47	1 47	1 47	1 47										43
51	1 50	1 48	1 48	1 47	1 47	1 46	1 46										44
52	1 50	1 48	1 48	1 48	1 47	1 46											46
53	1 51	1 49	1 48	1 48	1 47	1 46											48
54	1 52	1 50	1 49	1 48	1 47												50
54	1 52	1 50	1 49	1 48													52
55	1 52	1 50	1 50														54
56	1 53	1 51															56
56	1 53																58
56																	60
																	62
																	64
																	66
																	68
																	70
																	72
																	74
																	76
																	78
																	80
																	82
																	84
																	86
4°	36°	38°	40°	42°	44°	46°	50°	54°	58°	62°	66°	70°	74°	78°	82°	86°	

TABLE 36.

Apparent Distance, 90°

Apparent Altitude of the Sun or Star.

☾'s Alt.	6°	7°	8°	9°	10°	11°	12°	14°	16°	18°	20°	22°	24°	26°	28°	30°	32°	☾ Al
	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	
6°	1 55	1 57	1 59	2 2	2 7	2 12	2 18	2 31	2 45	2 59	3 16	3 29	3 44	4 1	4 14	4 29	4 43	
7	1 58	1 56	1 57	1 59	2 2	2 6	2 10	2 19	2 30	2 42	2 54	3 7	3 20	3 32	3 44	3 56	4 8	
8	2 1	1 58	1 56	1 57	1 59	2 1	2 4	2 11	2 20	2 30	2 40	2 51	3 2	3 12	3 22	3 33	3 44	
9	2 5	2 1	1 58	1 56	1 57	1 59	2 1	2 6	2 13	2 21	2 29	2 38	2 48	2 57	3 6	3 15	3 25	
10	2 10	2 4	2 0	1 58	1 56	1 57	1 59	2 3	2 8	2 14	2 21	2 28	2 37	2 45	2 53	3 1	3 9	10
11	2 16	2 8	2 3	2 0	1 58	1 56	1 57	2 0	2 4	2 9	2 15	2 21	2 28	2 35	2 42	2 50	2 57	11
12	2 22	2 13	2 7	2 3	2 0	1 57	1 56	1 58	2 1	2 5	2 10	2 15	2 21	2 27	2 33	2 40	2 47	12
13	2 29	2 18	2 11	2 6	2 2	1 59	1 57	1 57	1 59	2 2	2 6	2 10	2 15	2 21	2 26	2 32	2 38	13
14	2 36	2 24	2 15	2 9	2 4	2 1	1 59	1 56	1 58	2 0	2 3	2 6	2 10	2 15	2 20	2 25	2 30	14
15	2 42	2 29	2 19	2 12	2 7	2 3	2 0	1 57	1 57	1 58	2 1	2 3	2 7	2 11	2 16	2 20	2 25	15
16	2 49	2 35	2 23	2 16	2 10	2 5	2 1	1 58	1 56	1 57	1 59	2 1	2 4	2 8	2 12	2 16	2 20	16
17	2 57	2 40	2 28	2 20	2 13	2 8	2 3	1 59	1 56	1 56	1 58	2 0	2 2	2 5	2 8	2 12	2 15	17
18	3 5	2 46	2 33	2 24	2 16	2 10	2 6	2 1	1 57	1 55	1 57	1 59	2 1	2 3	2 5	2 8	2 12	18
19	3 13	2 52	2 38	2 28	2 19	2 13	2 8	2 2	1 58	1 56	1 56	1 57	1 59	2 1	2 3	2 6	2 9	19
20	3 20	2 58	2 44	2 32	2 23	2 16	2 11	2 4	1 59	1 57	1 55	1 56	1 57	1 59	2 1	2 4	2 6	20
21	3 28	3 5	2 50	2 37	2 27	2 20	2 14	2 6	2 1	1 58	1 56	1 55	1 56	1 58	2 0	2 2	2 4	21
22	3 35	3 11	2 55	2 42	2 31	2 23	2 17	2 8	2 2	1 59	1 56	1 55	1 56	1 57	1 58	2 0	2 2	22
23	3 43	3 18	3 0	2 46	2 35	2 27	2 21	2 10	2 4	2 0	1 57	1 55	1 55	1 56	1 57	1 58	2 0	23
24	3 50	3 24	3 5	2 51	2 39	2 30	2 24	2 12	2 5	2 1	1 58	1 56	1 55	1 55	1 56	1 57	1 59	24
25	3 58	3 30	3 11	2 55	2 43	2 34	2 27	2 15	2 7	2 2	1 59	1 56	1 55	1 55	1 56	1 57	1 58	25
26	4 5	3 36	3 16	3 0	2 47	2 38	2 31	2 18	2 9	2 4	2 0	1 57	1 56	1 55	1 55	1 56	1 57	26
27	4 13	3 42	3 22	3 5	2 51	2 41	2 33	2 20	2 11	2 5	2 1	1 58	1 56	1 55	1 55	1 56	1 56	27
28	4 20	3 48	3 27	3 9	2 55	2 45	2 36	2 23	2 13	2 7	2 2	1 58	1 56	1 55	1 55	1 55	1 56	28
29	4 27	3 54	3 32	3 14	2 59	2 49	2 40	2 25	2 15	2 8	2 3	1 59	1 57	1 56	1 55	1 55	1 55	29
30	4 35	4 0	3 37	3 18	3 3	2 52	2 43	2 28	2 17	2 9	2 4	2 0	1 57	1 56	1 55	1 55	1 55	30
31	4 42	4 6	3 43	3 23	3 7	2 56	2 46	2 31	2 19	2 11	2 5	2 1	1 58	1 56	1 55	1 55	1 55	31
32	4 49	4 12	3 48	3 28	3 12	3 0	2 49	2 33	2 21	2 12	2 7	2 3	1 59	1 57	1 56	1 55	1 55	32
33	4 56	4 18	3 54	3 33	3 16	3 4	2 53	2 35	2 23	2 14	2 8	2 4	2 0	1 57	1 56	1 56	1 55	33
34	5 3	4 24	3 59	3 37	3 20	3 7	2 56	2 38	2 25	2 16	2 10	2 5	2 1	1 58	1 57	1 56	1 55	34
35	5 10	4 30	4 4	3 42	3 24	3 11	2 59	2 41	2 27	2 18	2 11	2 6	2 2	1 59	1 57	1 56	1 55	35
36	5 17	4 36	4 9	3 46	3 28	3 14	3 2	2 43	2 29	2 20	2 13	2 7	2 3	2 0	1 58	1 57	1 56	36
37	5 24	4 42	4 14	3 51	3 32	3 18	3 5	2 46	2 32	2 22	2 14	2 8	2 4	2 1	1 59	1 57	1 56	37
38	5 30	4 48	4 19	3 56	3 36	3 21	3 8	2 49	2 34	2 24	2 16	2 10	2 5	2 2	2 0	1 58	1 56	38
39	5 37	4 54	4 24	4 0	3 40	3 25	3 11	2 52	2 36	2 25	2 17	2 11	2 6	2 2	2 0	1 58	1 57	39
40	5 43	4 59	4 29	4 4	3 44	3 28	3 14	2 54	2 38	2 27	2 19	2 12	2 7	2 3	2 1	1 59	1 57	40
41	5 50	5 5	4 34	4 8	3 48	3 32	3 17	2 57	2 41	2 29	2 20	2 13	2 8	2 4	2 1	1 59	1 57	41
42	5 56	5 10	4 39	4 12	3 52	3 35	3 20	2 59	2 43	2 31	2 22	2 14	2 9	2 5	2 2	2 0	1 58	42
43	6 3	5 16	4 44	4 17	3 56	3 39	3 23	3 2	2 45	2 33	2 23	2 16	2 10	2 6	2 3	2 0	1 58	43
44	6 9	5 22	4 49	4 21	4 0	3 42	3 26	3 4	2 47	2 35	2 25	2 17	2 11	2 7	2 4	2 1	1 59	44
46	6 21	5 32	4 58	4 29	4 7	3 49	3 32	3 9	2 51	2 38	2 28	2 20	2 13	2 9	2 5	2 2	2 0	46
48	6 33	5 42	5 7	4 37	4 14	3 55	3 38	3 14	2 55	2 42	2 31	2 22	2 15	2 11	2 7	2 4	2 1	48
50	6 43	5 52	5 15	4 44	4 20	4 1	3 44	3 18	3 0	2 45	2 34	2 25	2 17	2 12	2 8	2 5	2 2	50
52	6 54	6 1	5 23	4 51	4 26	4 6	3 50	3 22	3 3	2 49	2 37	2 28	2 20	2 14	2 9	2 6	2 3	52
54	7 4	6 10	5 31	4 58	4 32	4 12	3 55	3 26	3 7	2 52	2 40	2 30	2 22	2 16	2 11	2 7	2 4	54
56	7 13	6 19	5 38	5 5	4 38	4 17	4 0	3 30	3 10	2 55	2 43	2 33	2 24	2 18	2 12	2 8	2 5	56
58	7 23	6 27	5 45	5 11	4 43	4 22	4 5	3 34	3 13	2 58	2 45	2 35	2 26	2 20	2 14	2 9	2 6	58
60	7 32	6 35	5 52	5 16	4 49	4 27	4 9	3 38	3 16	3 1	2 48	2 37	2 28	2 21	2 16	2 10		60
62	7 40	6 42	5 58	5 21	4 54	4 32	4 13	3 42	3 19	3 3	2 50	2 39	2 30	2 22	2 17			62
64	7 48	6 49	6 4	5 26	4 59	4 37	4 17	3 46	3 22	3 6	2 52	2 40	2 31	2 23				64
66	7 56	6 55	6 9	5 31	5 4	4 41	4 21	3 49	3 25	3 8	2 53	2 42	2 33					66
68	8 3	7 0	6 14	5 36	5 8	4 45	4 24	3 52	3 28	3 10	2 54	2 43						68
70	8 9	7 5	6 19	5 40	5 12	4 48	4 27	3 54	3 30	3 11	2 56							70
72	8 15	7 10	6 23	5 44	5 15	4 51	4 29	3 56	3 32	3 12								72
74	8 20	7 14	6 27	5 48	5 18	4 53	4 31	3 57	3 33									74
76	8 24	7 18	6 30	5 51	5 21	4 55	4 33	3 59										76
78	8 27	7 21	6 33	5 53	5 23	4 57	4 35											78
80	8 29	7 23	6 35	5 56	5 25													80
82	8 32	7 26	6 37															82
84	8 34																	84
86																		86
	6°	7°	8°	9°	10°	11°	12°	14°	16°	18°	20°	2					32°	

TABLE 36.

APPARENT DISTANCE, 90°

Apparent Altitude of the Sun or Star.

34°	36°	38°	40°	42°	44°	46°	50°	54°	58°	62°	66°	70°	74°	78°	82°	86°	☾'s
′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	Alt.
4 58	5 12	5 26	5 39	5 52	6 4	6 17	6 40	7 1	7 20	7 38	7 54	8 7	8 17	8 25	8 34		6°
4 20	4 32	4 44	4 55	5 7	5 18	5 29	5 49	6 8	6 25	6 40	6 53	7 5	7 13	7 19	7 28		7
3 55	4 6	4 16	4 26	4 36	4 46	4 55	5 13	5 29	5 44	5 57	6 9	6 19	6 27	6 33	6 39		8
3 34	3 44	3 53	4 2	4 11	4 19	4 27	4 42	4 56	5 9	5 20	5 29	5 38	5 47	5 52			9
3 17	3 26	3 34	3 41	3 49	3 57	4 4	4 18	4 30	4 42	4 53	5 2	5 11	5 18	5 23			10
3 5	3 12	3 19	3 26	3 33	3 40	3 46	3 59	4 10	4 20	4 30	4 39	4 47	4 53	4 57			11
2 54	3 1	3 7	3 13	3 19	3 25	3 31	3 43	3 53	4 3	4 11	4 19	4 26	4 32	4 36			12
2 44	2 50	2 56	3 2	3 8	3 13	3 19	3 29	3 38	3 47	3 56	4 3	4 9	4 13				13
2 36	2 41	2 47	2 52	2 58	3 3	3 8	3 17	3 26	3 34	3 41	3 48	3 53	3 57				14
2 30	2 35	2 39	2 44	2 49	2 54	2 58	3 7	3 15	3 22	3 29	3 35	3 40	3 45				15
2 24	2 29	2 33	2 37	2 42	2 46	2 50	2 58	3 5	3 11	3 18	3 24	3 29	3 34				16
2 19	2 24	2 28	2 32	2 36	2 39	2 43	2 50	2 57	3 3	3 9	3 15	3 20					17
2 15	2 19	2 23	2 26	2 30	2 33	2 37	2 44	2 50	2 56	3 2	3 7	3 11					18
2 12	2 15	2 19	2 22	2 25	2 28	2 32	2 38	2 44	2 50	2 55	3 0	3 3					19
2 9	2 12	2 15	2 18	2 21	2 24	2 27	2 33	2 39	2 44	2 49	2 53	2 56					20
2 6	2 9	2 12	2 15	2 17	2 20	2 22	2 28	2 34	2 39	2 43	2 47						21
2 4	2 6	2 9	2 11	2 13	2 15	2 18	2 24	2 29	2 34	2 38	2 41						22
2 2	2 4	2 6	2 8	2 10	2 12	2 15	2 20	2 25	2 30	2 34	2 37						23
2 0	2 2	2 4	2 6	2 8	2 10	2 12	2 17	2 21	2 26	2 30	2 33						24
1 59	2 0	2 2	2 4	2 6	2 8	2 10	2 14	2 18	2 22	2 26							25
1 58	1 59	2 1	2 3	2 4	2 6	2 8	2 11	2 15	2 19	2 22							26
1 57	1 58	2 0	2 2	2 3	2 5	2 6	2 9	2 13	2 16	2 19							27
1 57	1 58	1 59	2 1	2 2	2 3	2 4	2 7	2 11	2 14	2 16							28
1 56	1 57	1 58	1 59	2 1	2 2	2 3	2 6	2 9	2 11								29
1 56	1 56	1 57	1 58	2 0	2 1	2 2	2 5	2 7	2 9								30
1 55	1 55	1 56	1 57	1 59	2 0	2 1	2 3	2 5	2 7								31
1 55	1 55	1 56	1 57	1 58	1 59	2 0	2 2	2 4	2 5								32
1 55	1 55	1 55	1 56	1 57	1 58	1 59	2 1	2 2									33
1 54	1 55	1 55	1 56	1 57	1 57	1 58	2 0	2 1									34
1 54	1 55	1 55	1 55	1 56	1 56	1 57	1 59	2 0									35
1 55	1 55	1 55	1 55	1 56	1 56	1 57	1 58	1 59									36
1 55	1 55	1 54	1 54	1 55	1 55	1 56	1 57										37
1 55	1 55	1 54	1 54	1 55	1 55	1 56	1 57										38
1 56	1 55	1 54	1 54	1 55	1 55	1 55	1 56										39
1 56	1 55	1 54	1 54	1 54	1 54	1 55	1 56										40
1 56	1 55	1 55	1 54	1 54	1 54	1 54											41
1 56	1 55	1 55	1 54	1 54	1 54	1 54											42
1 57	1 55	1 55	1 55	1 54	1 54	1 54											43
1 57	1 55	1 55	1 55	1 54	1 54	1 53											44
1 58	1 55	1 56	1 55	1 54	1 54												46
1 59	1 58	1 57	1 56	1 55													48
2 0	1 58	1 57	1 56														50
2 1	1 59	1 57															52
2 1	1 59																54
2 2																	56
																	58
																	60
																	62
																	64
																	66
																	68
																	70
																	72
																	74
																	76
																	78
																	80
																	82
																	84
																	86
34°	36°	38°	40°	42°	44°	46°	50°	54°	58°	62°	66°	70°	74°	78°	82°	86°	

TABLE 36.

Apparent Distance, 94°

Apparent Altitude of the Sun or Star.

[illegible]	6°	7°	8°	9°	10°	11°	12°	14°	16°	18°	20°	22°	24°	26°	28°	30°	32°	[illegible]
	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	
6	2 2	2 4	2 6	2 9	2 13	2 18	2 24	2 37	2 51	3 6	3 22	3 37	3 52	4 7	4 22	4 37	4 52	6
7	2 3	2 2	2 4	2 6	2 8	2 13	2 16	2 25	2 36	2 48	3 2	3 14	3 27	3 39	3 52	4 4	4 16	7
8	2 5	2 4	2 2	2 3	2 5	2 8	2 11	2 18	2 27	2 36	2 47	2 58	3 9	3 20	3 30	3 41	3 52	8
9	2 12	2 7	2 4	2 2	2 3	2 5	2 8	2 13	2 20	2 27	2 36	2 45	2 55	3 4	3 14	3 23	3 33	9
10	2 16	2 10	2 6	2 4	2 2	2 3	2 5	2 9	2 14	2 20	2 28	2 36	2 44	2 52	3 0	3 8	3 17	10
11	2 22	2 14	2 9	2 6	2 4	2 2	2 3	2 6	2 10	2 15	2 21	2 28	2 35	2 42	2 49	2 57	3 5	11
12	2 28	2 19	2 13	2 9	2 6	2 4	2 2	2 4	2 7	2 11	2 16	2 22	2 28	2 34	2 41	2 48	2 55	12
13	2 33	2 24	2 17	2 12	2 8	2 5	2 3	2 3	2 5	2 8	2 12	2 17	2 22	2 28	2 34	2 40	2 46	13
14	2 42	2 30	2 21	2 15	2 10	2 7	2 5	2 2	2 4	2 6	2 9	2 14	2 18	2 23	2 28	2 33	2 38	14
15	2 48	2 35	2 25	2 19	2 13	2 10	2 7	2 3	2 3	2 5	2 7	2 11	2 14	2 19	2 23	2 28	2 32	15
16	2 57	2 41	2 30	2 22	2 16	2 12	2 9	2 4	2 2	2 4	2 6	2 8	2 11	2 15	2 19	2 23	2 27	16
17	3 4	2 47	2 35	2 26	2 19	2 15	2 11	2 6	2 3	2 3	2 5	2 7	2 9	2 12	2 16	2 19	2 23	17
18	3 [illegible]	2 53	2 40	2 30	2 22	2 17	2 13	2 7	2 4	2 2	2 4	2 6	2 8	2 10	2 13	2 16	2 20	18
19	3 18	2 58	2 45	2 34	2 26	2 20	2 15	2 9	2 5	2 3	2 3	2 4	2 6	2 8	2 11	2 14	2 17	19
20	3 25	3 3	2 51	2 38	2 30	2 23	2 19	2 11	2 7	2 4	2 2	2 3	2 5	2 7	2 9	2 11	2 14	20
21	3 34	3 12	2 57	2 44	2 33	2 26	2 21	2 13	2 8	2 5	2 3	2 3	2 4	2 5	2 7	2 9	2 12	21
22	3 42	3 17	3 2	2 48	2 37	2 29	2 24	2 15	2 10	2 6	2 4	2 2	2 3	2 4	2 6	2 8	2 10	22
23	3 51	3 23	3 7	2 53	2 41	2 33	2 27	2 17	2 11	2 7	2 4	2 2	2 2	2 3	2 5	2 6	2 8	23
24	3 57	3 32	3 12	2 57	2 45	2 37	2 31	2 19	2 13	2 8	2 5	2 3	2 2	2 3	2 4	2 5	2 6	24
25	4 3	3 37	3 16	3 2	2 49	2 41	2 34	2 22	2 15	2 9	2 6	2 4	2 2	2 3	2 4	2 4	2 5	25
26	4 [illegible]	3 43	3 23	3 7	2 53	2 44	2 37	2 25	2 17	2 11	2 8	2 5	2 3	2 2	2 3	2 4	2 5	26
27	4 24	3 44	3 28	3 11	2 56	2 48	2 40	2 27	2 19	2 13	2 9	2 6	2 4	2 2	2 2	2 3	2 4	27
28	4 27	3 50	3 34	3 17	3 2	2 51	2 43	2 30	2 20	2 14	2 10	2 6	2 4	2 3	2 2	2 3	2 3	28
29	4 32	4 5	3 40	3 22	3 6	2 55	2 46	2 32	2 22	2 16	2 11	2 7	2 5	2 4	2 3	2 2	2 3	29
30	4 42	4 5	3 45	3 25	3 10	2 59	2 49	2 35	2 24	2 17	2 12	2 8	2 5	2 4	2 3	2 2	2 3	30
31	4 48	4 10	3 52	3 31	3 23	3 3	2 53	2 38	2 26	2 19	2 13	2 9	2 6	2 4	2 3	2 3	2 2	31
32	4 50	4 21	3 56	3 33	3 24	3 7	2 57	2 40	2 28	2 20	2 15	2 11	2 6	2 5	2 4	2 3	2 2	32
33	5 5	4 29	4 1	3 41	3 23	3 11	3 0	2 43	2 30	2 22	2 16	2 12	2 7	2 5	2 4	2 3	2 2	33
34	5 11	4 32	4 [illegible]	3 44	3 25	3 15	3 3	2 45	2 32	2 24	2 17	2 13	2 9	2 6	2 4	2 4	2 3	34
35	5 [illegible]	4 36	4 22	3 51	3 32	3 19	3 7	2 48	2 34	2 26	2 19	2 14	2 10	2 7	2 5	2 4	2 3	35
36	5 [illegible]	4 44	4 [illegible]	3 53	3 36	3 22	3 10	2 50	2 36	2 28	2 21	2 15	2 11	2 8	2 6	2 5	2 4	36
37	5 [illegible]	4 51	4 22	3 54	3 40	3 25	3 13	2 53	2 39	2 29	2 22	2 16	2 12	2 9	2 7	2 5	2 4	37
38	5 [illegible]	4 56	4 27	4 4	3 44	3 28	3 16	2 56	2 41	2 31	2 23	2 18	2 13	2 10	2 8	2 6	2 4	38
39	5 45	5 2	4 32	4 5	3 45	3 32	3 19	2 58	2 43	2 33	2 25	2 19	2 14	2 11	2 8	2 6	2 5	39
40	5 [illegible]	5 [illegible]	4 57	4 12	3 52	3 36	3 22	3 1	2 46	2 35	2 26	2 20	2 15	2 11	2 9	2 7	2 5	40
41	5 56	5 13	4 42	4 17	3 58	3 38	3 25	3 3	2 48	2 37	2 28	2 21	2 16	2 12	2 9	2 7	2 5	41
42	6 4	5 18	4 47	4 21	3 59	3 43	3 28	3 6	2 50	2 38	2 29	2 22	2 17	2 13	2 10	2 8	2 6	42
43	6 11	5 24	4 52	4 28	4 3	3 46	3 31	3 9	2 53	2 40	2 31	2 24	2 18	2 14	2 11	2 8	2 6	43
44	6 15	5 29	4 57	4 28	4 7	3 54	3 34	3 12	2 55	2 42	2 32	2 25	2 19	2 15	2 12	2 9	2 7	44
46	6 28	5 41	5 6	4 57	4 14	3 56	3 41	3 17	2 59	2 46	2 35	2 27	2 22	2 17	2 13	2 10	2 8	46
48	6 41	5 34	5 13	4 45	4 21	4 3	3 46	3 22	3 3	2 49	2 38	2 30	2 24	2 19	2 15	2 12	2 9	48
50	6 51	6 4	5 25	4 52	4 25	4 9	3 52	3 26	3 7	2 52	2 41	2 33	2 26	2 21	2 17	2 13	2 10	50
52	7 1	6 9	5 32	4 54	4 34	4 13	3 56	3 30	3 11	2 55	2 44	2 35	2 28	2 23	2 18	2 14	2 11	52
54	7 11	6 15	5 39	5 6	4 40	4 20	4 3	3 34	3 15	2 59	2 47	2 38	2 30	2 24	2 19	2 15	2 11	54
56	7 21	6 27	5 45	5 12	4 46	4 25	4 6	3 38	3 18	3 2	2 50	2 41	2 32	2 26	2 20	2 15		56
58	7 51	6 33	5 33	5 15	4 51	4 56	4 12	3 42	3 21	3 5	2 53	2 43	2 35	2 27	2 21			58
60	7 47	6 43	6 0	5 25	4 52	4 53	4 17	3 46	3 24	3 8	2 55	2 45	2 36	2 29				60
62	7 48	6 48	6 6	5 34	5 2	4 47	4 21	3 50	3 27	3 11	2 57	2 46	2 38					62
64	7 52	6 56	6 13	5 32	5 7	4 44	4 25	3 54	3 30	3 13	2 59	2 47						64
66	8 3	7 3	6 17	5 45	5 12	4 48	4 29	3 57	3 33	3 15	3 0							66
68	8 12	7 9	6 22	5 43	5 16	4 52	4 32	3 59	3 36	3 17								68
70	8 19	7 14	6 27	5 49	5 20	4 56	4 33	4 1	3 38									70
72	8 24	7 19	6 32	5 53	5 23	4 59	4 37	4 3										72
74	8 29	7 23	6 33	5 57	5 26	5 1	4 39											74
76	8 33	7 17	6 36	6 0	5 29													76
78	8 36	7 30	6 41															78
80	8 38																	80
82																		82
84																		84
86																		86

Apparent Distance, 94°

Apparent Altitude of the Sun or Star.

34°	36°	38°	40°	42°	44°	46°	50°	54°	58°	62°	66°	70°	74°	78°	82°	86°	☾'s Alt.
′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	
5 6	5 20	5 34	5 47	6 0	6 12	6 25	6 48	7 9	7 29	7 47	8 4	8 17	8 27	8 35			6°
4 28	4 40	4 52	5 4	5 15	5 26	5 37	5 57	6 16	6 33	6 48	7 2	7 14	7 23	7 30			7
4 3	4 14	4 24	4 34	4 44	4 53	5 3	5 21	5 37	5 52	6 5	6 17	6 27	6 35	6 42			8
3 42	3 51	4 0	4 9	4 18	4 26	4 35	4 48	5 5	5 18	5 29	5 39	5 48	5 56				9
3 25	3 33	3 41	3 49	3 57	4 4	4 12	4 26	4 38	4 50	5 1	5 11	5 19	5 25				10
3 12	3 20	3 26	3 33	3 40	3 47	3 54	4 7	4 18	4 28	4 38	4 47	4 55	5 2				11
3 1	3 8	3 14	3 21	3 27	3 33	3 40	3 51	4 1	4 10	4 19	4 27	4 34	4 41				12
2 51	2 57	3 3	3 10	3 16	3 21	3 27	3 37	3 46	3 55	4 4	4 11	4 17					13
2 43	2 48	2 54	3 0	3 5	3 10	3 16	3 25	3 34	3 43	3 50	3 56	4 1					14
2 37	2 42	2 46	2 51	2 56	3 1	3 6	3 15	3 23	3 31	3 38	3 44	3 49					15
2 32	2 36	2 40	2 45	2 49	2 53	2 58	3 6	3 13	3 20	3 27	3 33	3 38					16
2 27	2 31	2 35	2 39	2 43	2 47	2 51	2 58	3 5	3 11	3 17	3 23						17
2 23	2 27	2 31	2 34	2 38	2 41	2 45	2 52	2 58	3 4	3 10	3 15						18
2 20	2 23	2 27	2 30	2 33	2 36	2 40	2 46	2 52	2 58	3 3	3 7						19
2 17	2 20	2 23	2 26	2 29	2 32	2 35	2 41	2 47	2 52	2 57	3 0						20
2 14	2 17	2 20	2 22	2 25	2 27	2 30	2 36	2 42	2 47	2 51							21
2 12	2 14	2 17	2 19	2 21	2 23	2 26	2 31	2 37	2 42	2 46							22
2 10	2 12	2 14	2 16	2 18	2 20	2 23	2 28	2 33	2 38	2 41							23
2 8	2 10	2 12	2 14	2 16	2 18	2 20	2 25	2 29	2 34	2 37							24
2 7	2 8	2 10	2 12	2 14	2 16	2 18	2 22	2 26	2 30								25
2 6	2 7	2 9	2 10	2 12	2 14	2 16	2 20	2 23	2 27								26
2 5	2 6	2 8	2 9	2 11	2 13	2 15	2 18	2 20	2 23								27
2 4	2 5	2 7	2 8	2 10	2 12	2 13	2 16	2 18	2 20								28
2 3	2 4	2 6	2 7	2 9	2 10	2 12	2 14	2 16									29
2 3	2 4	2 5	2 6	2 8	2 9	2 10	2 13	2 15									30
2 3	2 3	2 4	2 5	2 7	2 8	2 9	2 11	2 13									31
2 3	2 3	2 4	2 5	2 6	2 7	2 8	2 10	2 11									32
2 2	2 3	2 3	2 4	2 5	2 6	2 7	2 9										33
2 2	2 3	2 3	2 4	2 5	2 5	2 6	2 8										34
2 2	2 2	2 3	2 4	2 4	2 5	2 6	2 7										35
2 3	2 2	2 2	2 3	2 4	2 5	2 6	2 6										36
2 3	2 2	2 2	2 3	2 4	2 4	2 5											37
2 3	2 3	2 2	2 2	2 3	2 4	2 5											38
2 4	2 3	2 2	2 2	2 3	2 3	2 4											39
2 4	2 3	2 2	2 2	2 3	2 3	2 3											40
2 4	2 3	2 3	2 2	2 2	2 2												41
2 4	2 3	2 3	2 2	2 2	2 2												42
2 5	2 4	2 3	2 2	2 1													43
2 5	2 4	2 3	2 2	2 1													44
2 6	2 5	2 4	2 3														46
2 7	2 5	2 4															48
2 8	2 6																50
2 8																	52
																	54
																	56
																	58
																	60
																	62
																	64
																	66
																	68
																	70
																	72
																	74
																	76
																	78
																	80
																	82
																	84
																	86

TABLE 36.

APPARENT DISTANCE, 98°

Apparent Altitude of the Sun or Star.

☽'s Alt.	6°	7°	8°	9°	10°	11°	12°	14°	16°	18°	20°	22°	24°	26°	28°	30°	32°	☽'
	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	″ ′	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	
6°	2 9	2 11	2 14	2 17	2 21	2 26	2 32	2 45	2 59	3 14	3 29	3 44	4 0	4 15	4 30	4 45	5 0	
7	2 12	2 9	2 11	2 13	2 16	2 21	2 24	2 33	2 44	2 56	3 9	3 21	3 34	3 46	3 59	4 12	4 24	
8	2 15	2 11	2 9	2 10	2 12	2 15	2 19	2 26	2 35	2 44	2 55	3 6	3 17	3 28	3 39	3 49	4 0	
9	2 19	2 14	2 11	2 9	2 10	2 12	2 15	2 21	2 28	2 35	2 44	2 53	3 3	3 12	3 22	3 31	3 41	9
10	2 24	2 18	2 14	2 11	2 9	2 10	2 12	2 17	2 22	2 28	2 36	2 44	2 52	3 0	3 8	3 16	3 26	
11	2 29	2 22	2 17	2 13	2 11	2 9	2 10	2 14	2 18	2 23	2 29	2 36	2 43	2 50	2 57	3 5	3 13	11
12	2 36	2 26	2 20	2 16	2 13	2 10	2 9	2 12	2 15	2 19	2 24	2 30	2 36	2 42	2 49	2 56	3 3	
13	2 43	2 31	2 24	2 19	2 15	2 12	2 10	2 10	2 13	2 16	2 20	2 25	2 30	2 36	2 41	2 47	2 54	
14	2 50	2 36	2 28	2 22	2 17	2 14	2 12	2 9	2 11	2 14	2 17	2 21	2 26	2 31	2 35	2 40	2 46	14
15	2 57	2 42	2 32	2 25	2 20	2 17	2 14	2 10	2 10	2 12	2 15	2 18	2 22	2 26	2 31	2 35	2 40	
16	3 4	2 48	2 37	2 29	2 23	2 19	2 16	2 12	2 9	2 11	2 13	2 16	2 19	2 23	2 27	2 31	2 35	
17	3 11	2 54	2 42	2 33	2 26	2 22	2 18	2 13	2 10	2 10	2 12	2 14	2 17	2 20	2 24	2 27	2 31	
18	3 19	3 0	2 47	2 37	2 29	2 24	2 20	2 15	2 11	2 9	2 11	2 13	2 15	2 18	2 21	2 24	2 27	
19	3 26	3 7	2 52	2 41	2 33	2 27	2 22	2 16	2 12	2 10	2 10	2 12	2 13	2 16	2 18	2 21	2 24	
20	3 34	3 13	2 58	2 46	2 37	2 30	2 25	2 18	2 14	2 11	2 9	2 11	2 12	2 14	2 16	2 19	2 21	
21	3 41	3 20	3 4	2 51	2 41	2 34	2 28	2 20	2 15	2 12	2 10	2 10	2 11	2 13	2 15	2 17	2 19	21
22	3 49	3 26	3 9	2 55	2 45	2 37	2 31	2 22	2 17	2 14	2 11	2 9	2 10	2 12	2 14	2 16	2 18	
[illegible]	3 57	3 32	3 15	3 0	2 49	2 41	2 34	2 24	2 19	2 15	2 12	2 9	2 9	2 11	2 13	2 15	2 17	
[illegible]	4 5	3 38	3 20	3 5	2 53	2 45	2 38	2 27	2 20	2 16	2 13	2 10	2 9	2 10	2 12	2 14	2 15	24
[illegible]	4 12	3 45	3 26	3 10	2 57	2 49	2 41	2 29	2 22	2 17	2 14	2 11	2 10	2 10	2 11	2 13	2 14	
26	4 20	3 51	3 31	3 15	3 1	2 52	2 44	2 32	2 24	2 19	2 15	2 12	2 10	2 10	2 11	2 12	2 13	26
27	4 27	3 57	3 37	3 19	3 6	2 56	2 47	2 34	2 26	2 20	2 16	2 13	2 11	2 10	2 10	2 11	2 12	
28	4 35	4 4	3 42	3 24	3 10	2 59	2 50	2 37	2 28	2 21	2 17	2 14	2 12	2 11	2 10	2 11	2 12	
29	4 42	4 10	3 48	3 29	3 14	3 3	2 54	2 39	2 30	2 23	2 20	2 15	2 13	2 11	2 10	2 10	2 11	
30	4 50	4 16	3 53	3 33	3 18	3 7	2 57	2 41	2 32	2 24	2 21	2 17	2 14	2 12	2 11	2 10	2 11	
31	4 57	4 22	3 59	3 38	3 22	3 11	3 1	2 44	2 34	2 26	2 22	2 18	2 15	2 13	2 11	2 10	2 10	31
32	5 4	4 28	4 4	3 43	3 27	3 14	3 4	2 47	2 36	2 28	2 23	2 19	2 16	2 13	2 12	2 11	2 10	32
33	5 11	4 34	4 9	3 48	3 31	3 18	3 7	2 50	2 38	2 29	2 24	2 20	2 17	2 14	2 12	2 11	2 10	33
34	5 18	4 40	4 15	3 53	3 36	3 22	3 11	2 52	2 40	2 31	2 25	2 21	2 18	2 15	2 13	2 12	2 11	34
35	5 25	4 46	4 20	3 58	3 40	3 26	3 14	2 55	2 42	2 33	2 27	2 22	2 19	2 16	2 14	2 12	2 11	35
36	5 32	4 52	4 25	4 3	3 44	3 30	3 18	2 58	2 44	2 35	2 28	2 24	2 20	2 16	2 14	2 13	2 12	36
37	5 39	4 58	4 30	4 7	3 48	3 33	3 21	3 1	2 47	2 37	2 30	2 25	2 21	2 17	2 15	2 13	2 12	37
38	5 46	5 4	4 35	4 12	3 52	3 37	3 24	3 3	2 49	2 39	2 31	2 26	2 22	2 18	2 16	2 14	2 13	38
39	5 53	5 10	4 40	4 16	3 56	3 40	3 27	3 6	2 51	2 41	2 33	2 27	2 23	2 19	2 17	2 15	2 13	39
40	5 59	5 16	4 45	4 20	4 0	3 44	3 30	3 9	2 54	2 43	2 34	2 28	2 24	2 20	2 17	2 15	2 14	40
41	6 6	5 22	4 50	4 24	4 4	3 48	3 34	3 12	2 56	2 45	2 36	2 29	2 25	2 21	2 18	2 16	2 14	41
42	6 13	5 28	4 55	4 28	4 8	3 51	3 37	3 14	2 58	2 47	2 37	2 31	2 26	2 22	2 19	2 17	2 15	42
43	6 19	5 33	5 0	4 33	4 12	3 55	3 40	3 17	3 1	2 49	2 39	2 32	2 27	2 23	2 20	2 17	2 15	43
44	6 25	5 39	5 5	4 37	4 15	3 58	3 43	3 20	3 3	2 51	2 41	2 33	2 28	2 24	2 21	2 18	2 16	44
46	6 37	5 49	5 14	4 45	4 22	4 4	3 49	3 25	3 6	2 54	2 43	2 36	2 30	2 26	2 22	2 19	2 17	46
48	6 49	5 59	5 23	4 53	4 29	4 11	3 55	3 30	3 11	2 57	2 46	2 38	2 32	2 28	2 24	2 20	2 17	48
50	7 0	6 9	5 31	5 0	4 36	4 17	4 1	3 34	3 15	3 0	2 49	2 41	2 35	2 30	2 25	2 21	2 18	50
52	7 10	6 19	5 40	5 9	4 43	4 23	4 7	3 39	3 19	3 4	2 52	2 44	2 37	2 32	2 27	2 22		52
54	7 19	6 28	5 48	5 16	4 50	4 29	4 12	3 43	3 23	3 7	2 55	2 46	2 39	2 33	2 28			54
56	7 30	6 37	5 55	5 22	4 56	4 34	4 17	3 47	3 27	3 11	2 58	2 49	2 41	2 34				56
58	7 40	6 45	6 2	5 28	5 1	4 39	4 21	3 51	3 31	3 14	3 1	2 51	2 43					58
60	7 50	6 52	6 9	5 34	5 6	4 44	4 26	3 55	3 34	3 17	3 3	2 54						60
62	7 59	6 59	6 15	5 40	5 11	4 49	4 30	3 59	3 37	3 19	3 5							62
64	8 7	7 6	6 21	5 45	5 16	4 53	4 34	4 2	3 40	3 21								64
66	8 15	7 13	6 26	5 51	5 21	4 57	4 38	4 5	3 42									66
68	8 22	7 19	6 32	5 56	5 26	5 1	4 40	4 8										68
70	8 29	7 24	6 37	6 0	5 30	5 5	4 43											70
72	8 34	7 29	6 41	6 4	5 33													72
74	8 38	7 33	6 45															74
76	8 42																	76
78																		78
80																		80
82																		82
84																		84
86																		86

TABLE 36.

Apparent Distance, 98°

Apparent Altitude of the Sun or Star.

34°	36°	38°	40°	42°	44°	46°	50°	54°	58°	62°	66°	70°	74°	78°	82°	86°	☽'s Alt.
′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	
5 14	5 29	5 43	5 56	6 9	6 22	6 35	6 58	7 19	7 40	7 58	8 14	8 28	8 38				6°
4 36	4 49	5 1	5 13	5 25	5 36	5 47	6 7	6 26	6 43	6 49	7 12	7 24	7 34				7
4 11	4 22	4 33	4 43	4 53	5 3	5 12	5 30	5 47	6 1	6 14	6 26	6 37	6 46				8
3 50	4 0	4 9	4 18	4 27	4 36	4 44	5 0	5 14	5 28	5 39	5 47	6 0					9
3 34	3 42	3 50	3 58	4 6	4 14	4 21	4 35	4 46	5 0	5 11	5 21	5 30					10
3 21	3 28	3 35	3 42	3 49	3 56	4 3	4 16	4 27	4 38	4 48	4 57	5 6					11
3 10	3 16	3 23	3 29	3 36	3 42	3 49	3 59	4 10	4 20	4 29	4 37	4 45					12
3 0	3 6	3 12	3 18	3 24	3 30	3 36	3 46	3 55	4 4	4 12	4 20						13
2 52	2 57	3 2	3 8	3 13	3 19	3 24	3 34	3 43	3 52	3 59	4 5						14
2 45	2 50	2 54	2 59	3 4	3 9	3 14	3 23	3 32	3 40	3 47	3 54						15
2 40	2 44	2 48	2 52	2 57	3 2	3 6	3 14	3 22	3 30	3 37	3 42						16
2 35	2 39	2 43	2 47	2 51	2 55	2 59	3 7	3 14	3 21	3 27							17
2 31	2 34	2 38	2 42	2 46	2 49	2 53	3 0	3 7	3 13	3 19							18
2 27	2 30	2 34	2 38	2 41	2 44	2 48	2 54	3 0	3 6	2 11							19
2 24	2 27	2 31	2 34	2 37	2 40	2 43	2 49	2 55	3 0	3 5							20
2 22	2 25	2 28	2 30	2 33	2 36	2 39	2 45	2 50	2 55								21
2 20	2 23	2 25	2 27	2 30	2 32	2 35	2 41	2 46	2 50								22
2 19	2 21	2 23	2 25	2 27	2 29	2 32	2 37	2 42	2 46								23
2 17	2 19	2 21	2 23	2 25	2 27	2 30	2 34	2 39	2 42								24
2 15	2 17	2 19	2 21	2 23	2 25	2 27	2 31	2 35									[illegible]
2 14	2 16	2 17	2 19	2 21	2 23	2 25	2 29	2 32									26
2 13	2 15	2 16	2 18	2 20	2 22	2 24	2 27	2 29									27
2 13	2 14	2 15	2 17	2 19	2 20	2 22	2 25	2 27									28
2 12	2 13	2 14	2 16	2 17	2 19	2 21	2 23										29
2 12	2 13	2 14	2 15	2 16	2 18	2 19	2 21										30
2 11	2 12	2 13	2 14	2 15	2 16	2 18	2 20										31
2 11	2 11	2 12	2 13	2 14	2 15	2 16	2 18										32
2 10	2 11	2 11	2 12	2 13	2 14	2 15											33
2 10	2 11	2 11	2 12	2 13	2 14	2 15											34
2 10	2 10	2 11	2 11	2 12	2 13	2 14											35
2 11	2 10	2 10	2 11	2 12	2 13	2 13											36
2 11	2 10	2 10	2 11	2 11	2 12												37
2 12	2 11	2 10	2 11	2 11	2 12												38
2 12	2 11	2 11	2 11	2 11													39
2 12	2 11	2 11	2 11	2 11													40
2 13	2 12	2 11	2 11														41
2 13	2 12	2 11	2 11														42
2 14	2 12	2 11															43
2 14	2 12	2 11															44
2 15	2 13																46
2 15																	48
																	50
																	52
																	54
																	56
																	58
																	60
																	62
																	64
																	66
																	68
																	70
																	72
																	74
																	76
																	78
																	80
																	82
																	84
																	86
34°	36°	38°	40°	42°	44°	46°	50°	54°	58°	62°	66°	70°	74°	78°	82°	86°	

TABLE 36.

APPARENT DISTANCE, 102°

Apparent Altitude of the Sun or Star.

☾'s Ap. Alt.	6°	7°	8°	9°	10°	11°	12°	14°	16°	18°	20°	22°	24°	26°	28°	30°	32°	☾'s Ap. Alt.
°	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	°
6	2 [illegible]	2 [illegible]	2 [illegible]	2 [illegible]	2 [illegible]	2 35	2 41	2 53	3 8	3 23	3 38	3 53	4 9	4 24	4 40	4 55	5 10	6
7	2 [illegible]	2 [illegible]	2 [illegible]	2 [illegible]	2 [illegible]	2 [illegible]	2 32	2 42	2 53	3 5	3 18	3 30	3 43	3 55	4 8	4 21	4 35	7
8	2 [illegible]	2 [illegible]	2 [illegible]	2 [illegible]	2 [illegible]	2 25	2 26	2 34	2 43	2 53	3 3	3 15	3 26	3 37	3 48	3 59	4 10	8
9	2 [illegible]	2 [illegible]	2 [illegible]	2 [illegible]	2 [illegible]	2 [illegible]	2 22	2 28	2 35	2 44	2 52	3 2	3 12	3 21	3 31	3 40	3 50	9
10	2 [illegible]	2 35	2 [illegible]	2 [illegible]	2 [illegible]	2 [illegible]	2 20	2 24	2 30	2 37	2 44	2 52	3 0	3 9	3 18	3 26	3 35	10
11	2 [illegible]	2 [illegible]	2 [illegible]	2 [illegible]	2 [illegible]	2 [illegible]	2 1[illegible]	2 21	2 26	2 31	2 37	2 44	2 51	2 59	3 6	3 14	3 22	11
12	2 [illegible]	2 [illegible]	2 [illegible]	2 [illegible]	2 [illegible]	2 [illegible]	2 17	2 19	2 23	2 27	2 32	2 38	2 44	2 51	2 57	3 4	3 11	12
13	2 [illegible]	2 [illegible]	2 [illegible]	2 [illegible]	2 [illegible]	2 [illegible]	2 15	2 18	2 21	2 24	2 28	2 33	2 38	2 44	2 50	2 56	3 2	13
14	2 [illegible]	2 [illegible]	2 [illegible]	2 [illegible]	2 [illegible]	2 [illegible]	2 20	2 17	2 20	2 22	2 25	2 29	2 34	2 39	2 43	2 49	2 54	14
15	3 [illegible]	2 [illegible]	2 [illegible]	2 [illegible]	2 [illegible]	2 [illegible]	2 22	2 18	2 18	2 20	2 23	2 26	2 30	2 34	2 38	2 43	2 48	15
16	3 [illegible]	2 [illegible]	2 [illegible]	2 [illegible]	2 [illegible]	2 27	2 24	2 20	2 17	2 19	2 21	2 24	2 27	2 30	2 34	2 39	2 43	16
17	3 [illegible]	3 2	2 [illegible]	2 [illegible]	2 34	2 29	2 26	2 21	2 18	2 18	2 20	2 22	2 25	2 28	2 31	2 35	2 39	17
18	3 [illegible]	3 [illegible]	2 [illegible]	2 43	2 37	2 32	2 28	2 23	2 19	2 17	2 19	2 21	2 23	2 26	2 29	2 32	2 36	18
19	3 [illegible]	3 [illegible]	3 [illegible]	2 [illegible]	2 [illegible]	2 35	2 30	2 24	2 20	2 18	2 18	2 20	2 21	2 24	2 26	2 29	2 33	19
20	3 [illegible]	3 [illegible]	3 6	2 [illegible]	2 43	2 38	2 33	2 26	2 22	2 19	2 17	2 19	2 20	2 22	2 24	2 27	2 30	20
21	3 [illegible]	3 [illegible]	3 [illegible]	2 [illegible]	2 48	2 42	2 36	2 28	2 23	2 20	2 18	2 18	2 19	2 21	2 23	2 25	2 2[illegible]	21
22	3 [illegible]	3 [illegible]	3 [illegible]	3 3	2 53	2 45	2 39	2 30	2 25	2 22	2 19	2 17	2 18	2 20	2 22	2 24	2 26	22
23	4 [illegible]	3 [illegible]	3 25	3 [illegible]	2 57	2 48	2 42	2 33	2 27	2 23	2 20	2 18	2 17	2 19	2 21	2 23	2 25	23
24	4 [illegible]	3 [illegible]	3 [illegible]	3 13	3 2	2 53	2 46	2 35	2 28	2 24	2 21	2 19	2 17	2 18	2 20	2 22	2 24	24
25	4 [illegible]	3 [illegible]	3 [illegible]	3 [illegible]	3 6	2 57	2 49	2 37	2 30	2 25	2 22	2 19	2 18	2 18	2 19	2 21	2 23	25
26	4 [illegible]	3 [illegible]	3 [illegible]	3 [illegible]	3 [illegible]	3 0	2 52	2 40	2 32	2 27	2 23	2 20	2 19	2 18	2 19	2 21	2 22	26
27	4 [illegible]	4 [illegible]	3 [illegible]	3 [illegible]	3 [illegible]	3 4	2 55	2 42	2 34	2 28	2 24	2 21	2 19	2 18	2 19	2 20	2 21	27
28	4 [illegible]	4 [illegible]	3 [illegible]	3 [illegible]	3 [illegible]	3 [illegible]	2 5[illegible]	2 44	2 36	2 29	2 25	2 22	2 20	2 19	2 19	2 20	2 21	28
29	4 [illegible]	4 [illegible]	3 [illegible]	3 [illegible]	3 25	3 11	3 2	2 47	2 38	2 30	2 26	2 23	2 21	2 20	2 19	2 19	2 20	29
30	4 [illegible]	4 [illegible]	4 3	3 42	3 27	3 15	3 5	2 50	2 40	2 32	2 28	2 25	2 22	2 20	2 19	2 19	2 20	30
31	3 [illegible]	4 [illegible]	4 [illegible]	3 [illegible]	3 [illegible]	3 [illegible]	3 [illegible]	2 53	2 42	2 34	2 29	2 26	2 23	2 21	2 20	2 19	2 19	31
32	[illegible]	4 [illegible]	4 [illegible]	3 [illegible]	3 36	3 23	3 12	2 55	2 44	2 36	2 31	2 27	2 24	2 22	2 21	2 20	2 19	32
33	[illegible]	4 [illegible]	4 [illegible]	3 [illegible]	3 4[illegible]	3 27	3 15	2 56	2 46	2 38	2 32	2 28	2 25	2 23	2 21	2 20	2 19	33
34	[illegible]	4 [illegible]	4 [illegible]	4 [illegible]	3 45	3 31	3 1[illegible]	3 0	2 48	2 40	2 34	2 29	2 26	2 24	2 22	2 21	2 20	34
35	[illegible]	4 [illegible]	4 [illegible]	4 [illegible]	3 49	3 35	3 22	3 3	2 51	2 42	2 35	2 30	2 27	2 25	2 23	2 21	2 20	35
36	3 [illegible]	3 [illegible]	4 [illegible]	4 [illegible]	3 53	3 38	3 2[illegible]	3 6	2 53	2 44	2 37	2 32	2 28	2 25	2 23	2 22	2 21	36
37	3 [illegible]	3 [illegible]	4 [illegible]	4 [illegible]	3 57	3 42	3 30	3 9	2 56	2 46	2 38	2 33	2 29	2 26	2 24	2 22	2 21	37
38	3 [illegible]	3 [illegible]	4 [illegible]	4 [illegible]	4 1	3 46	3 33	3 12	2 59	2 48	2 40	2 34	2 30	2 27	2 25	2 23	2 22	38
39	3 [illegible]	3 [illegible]	4 [illegible]	4 [illegible]	4 5	3 50	3 36	3 15	3 1	2 50	2 42	2 36	2 31	2 28	2 26	2 24	2 22	39
40	3 [illegible]	3 [illegible]	4 [illegible]	4 [illegible]	4 9	3 53	3 38	3 18	3 4	2 52	2 43	2 37	2 32	2 29	2 27	2 25	2 23	40
41	[illegible]	3 [illegible]	3 [illegible]	4 [illegible]	4 15	3 56	3 4[illegible]	3 21	3 6	2 54	2 45	2 39	2 34	2 30	2 27	2 25	2 23	41
42	3 [illegible]	3 [illegible]	3 3	4 [illegible]	4 [illegible]	4 0	3 47	3 24	3 9	2 56	2 46	2 40	2 35	2 31	2 28	2 26	2 24	42
43	3 [illegible]	3 [illegible]	3 [illegible]	4 [illegible]	4 [illegible]	4 4	3 50	3 27	3 10	2 58	2 48	2 41	2 36	2 32	2 29	2 26	2 24	43
44	3 [illegible]	3 [illegible]	3 [illegible]	4 [illegible]	4 [illegible]	4 7	3 53	3 29	3 13	3 0	2 50	2 43	2 37	2 33	2 30	2 27	2 25	44
45	3 [illegible]	3 [illegible]	3 [illegible]	4 [illegible]	4 [illegible]	4 1[illegible]	3 5[illegible]	3 34	3 17	3 3	2 53	2 46	2 40	2 35	2 31	2 28	2 26	45
48	[illegible]	3 [illegible]	3 [illegible]	3 [illegible]	4 [illegible]	4 [illegible]	4 3	3 3[illegible]	3 21	3 7	2 56	2 4[illegible]	2 42	2 37	2 33	2 29		48
50	[illegible]	3 [illegible]	3 [illegible]	3 [illegible]	4 [illegible]	4 [illegible]	4 11	3 44	3 [illegible]	3 10	2 59	2 51	2 44	2 39	2 34			50
52	[illegible]	3 [illegible]	3 [illegible]	3 [illegible]	4 [illegible]	4 [illegible]	4 17	3 48	3 [illegible]	3 14	3 2	2 54	2 47	2 40				52
54	[illegible]	3 [illegible]	3 [illegible]	3 [illegible]	3 [illegible]	4 [illegible]	4 22	3 53	3 33	3 17	3 5	2 56	2 48					54
56	[illegible]	3 [illegible]	3 [illegible]	3 [illegible]	3 [illegible]	4 [illegible]	4 27	3 57	3 5[illegible]	3 21	3 7	2 57						56
58	[illegible]	[illegible]	4 [illegible]	3 [illegible]	3 [illegible]	4 [illegible]	4 [illegible]	4 1	3 41	3 24	3 10							58
60	[illegible]	[illegible]	[illegible]	3 [illegible]	3 [illegible]	4 [illegible]	4 [illegible]	4 5	3 44	3 27								60
62	[illegible]	[illegible]	[illegible]	3 [illegible]	3 [illegible]	3 [illegible]	4 [illegible]	4 9	3 47									62
64	[illegible]	[illegible]	[illegible]	3 [illegible]	3 [illegible]	3 [illegible]	4 [illegible]	4 13										64
66	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3 [illegible]	4 [illegible]											66
68	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]													68
70	[illegible]	[illegible]	[illegible]															70
72	[illegible]																	72
74																		74
76																		76
78																		78
80																		80
82																		82
84																		84

TABLE 36.

APPARENT DISTANCE, 102°

Apparent Altitude of the Sun or Star.

34°	36°	38°	40°	42°	44°	46°	50°	54°	58°	62°	66°	70°	74°	78°	82°	86°	☾'s
′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	Alt.
5 25	5 39	5 54	6 8	6 21	6 34	6 47	7 11	7 32	7 53	8 12	8 27	8 41					6°
4 48	5 1	5 13	5 24	5 36	5 47	5 58	6 19	6 39	6 57	7 12	7 26	7 38					7
4 22	4 33	4 43	4 53	5 3	5 13	5 22	5 41	5 59	6 14	6 27	6 39	6 50					8
4 0	4 10	4 20	4 29	4 37	4 46	4 54	5 10	5 25	5 39	5 51	6 2						9
3 44	3 52	4 1	4 9	4 17	4 25	4 32	4 46	5 0	5 12	5 23	5 33						10
3 30	3 38	3 45	3 52	3 59	4 6	4 13	4 26	4 38	4 49	5 0	5 9						11
3 18	3 25	3 32	3 39	3 45	3 52	3 58	4 10	4 21	4 31	4 40	4 49						12
3 8	3 15	3 21	3 27	3 33	3 39	3 45	3 56	4 6	4 15	4 23							13
3 0	3 6	3 12	3 17	3 23	3 29	3 34	3 44	3 53	4 2	4 10							14
2 53	2 59	3 4	3 9	3 14	3 19	3 24	3 33	3 42	3 50	3 57							15
2 48	2 53	2 57	3 2	3 7	3 12	3 16	3 24	3 32	3 40	3 47							16
2 44	2 48	2 52	2 56	3 1	3 5	3 9	3 16	3 24	3 31								17
2 40	2 43	2 47	2 51	2 55	2 59	3 3	3 10	3 17	3 23								18
2 36	2 39	2 43	2 47	2 50	2 54	2 57	3 3	3 10	3 16								19
2 33	2 36	2 40	2 43	2 46	2 49	2 52	2 59	3 5	3 10								20
2 31	2 34	2 37	2 40	2 43	2 45	2 48	2 54	3 0									21
2 29	2 31	2 34	2 37	2 40	2 42	2 45	2 50	2 55									22
2 27	2 29	2 32	2 34	2 37	2 39	2 42	2 47	2 51									23
2 26	2 28	2 30	2 32	2 34	2 37	2 39	2 44	2 48									24
2 24	2 26	2 28	2 30	2 32	2 35	2 37	2 41										25
2 23	2 25	2 26	2 28	2 30	2 33	2 35	2 39										26
2 22	2 24	2 25	2 27	2 29	2 31	2 33	2 36										27
2 22	2 23	2 24	2 26	2 28	2 29	2 31	2 24										28
2 21	2 22	2 23	2 25	2 27	2 28	2 29											29
2 21	2 22	2 23	2 24	2 26	2 27	2 28											30
2 20	2 21	2 22	2 23	2 25	2 26	2 27											31
2 20	2 21	2 22	2 23	2 24	2 25	2 26											32
2 19	2 20	2 21	2 22	2 23	2 24												33
2 19	2 20	2 21	2 22	2 22	2 23												34
2 20	2 20	2 20	2 21	2 22													35
2 20	2 20	2 20	2 21	2 22													36
2 20	2 20	2 20	2 21														37
2 21	2 20	2 20	2 21														38
2 21	2 21	2 21															39
2 22	2 21	2 21															40
2 22	2 21																41
2 22	2 21																42
2 22																	43
2 22																	44
																	46
																	48
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																	74
																	76
																	78
																	80
																	82
																	84
																	86

TABLE 36.

Apparent Distance, 106°

Apparent Altitude of the Sun or Star.

☾'s Alt.	6°	7°	8°	9°	10°	11°	12°	14°	16°	18°	20°	22°	24°	26°	28°	30°	32°
	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″
6°	2 25	2 27	2 30	2 34	2 38	2 44	2 50	3 3	3 18	3 33	3 49	4 5	4 21	4 36	4 52	5 8	5 23
7	2 28	2 25	2 27	2 30	2 33	2 37	2 43	2 52	3 3	3 16	3 29	3 42	3 55	4 8	4 21	4 34	4 48
8	2 31	2 27	2 25	2 27	2 29	2 32	2 36	2 43	2 52	3 3	3 14	3 25	3 36	3 48	3 59	4 10	4 22
9	2 35	2 30	2 27	2 26	2 27	2 29	2 32	2 37	2 44	2 53	3 2	3 12	3 22	3 32	3 42	3 52	4 1
10	2 41	2 34	2 30	2 27	2 26	2 27	2 29	2 33	2 39	2 46	2 53	3 1	3 10	3 19	3 28	3 37	3 46
11	2 47	2 39	2 33	2 29	2 27	2 26	2 27	2 31	2 35	2 40	2 47	2 54	3 1	3 9	3 17	3 24	3 32
12	2 53	2 44	2 37	2 32	2 29	2 27	2 26	2 29	2 33	2 37	2 42	2 48	2 55	3 1	3 8	3 14	3 21
13	3 0	2 49	2 41	2 35	2 31	2 29	2 27	2 28	2 31	2 34	2 38	2 43	2 48	2 54	3 0	3 6	3 12
14	3 7	2 54	2 45	2 38	2 34	2 31	2 29	2 27	2 29	2 32	2 35	2 39	2 44	2 48	2 53	2 59	3 4
15	3 14	2 59	2 50	2 42	2 37	2 33	2 31	2 28	2 28	2 30	2 33	2 36	2 40	2 44	2 48	2 53	2 58
16	3 22	3 5	2 55	2 46	2 40	2 36	2 33	2 29	2 27	2 29	2 31	2 34	2 37	2 40	2 44	2 49	2 53
17	3 29	3 11	3 0	2 50	2 43	2 39	2 36	2 31	2 28	2 28	2 30	2 32	2 35	2 38	2 41	2 45	2 49
18	3 37	3 18	3 5	2 54	2 47	2 41	2 38	2 33	2 29	2 27	2 29	2 31	2 33	2 36	2 39	2 42	2 46
19	3 44	3 25	3 11	2 59	2 51	2 45	2 40	2 34	2 30	2 28	2 28	2 29	2 31	2 34	2 36	2 39	2 43
20	3 52	3 31	3 16	3 4	2 55	2 48	2 43	2 36	2 32	2 29	2 27	2 28	2 30	2 32	2 34	2 37	2 40
21	4 0	3 38	3 22	3 8	2 58	2 51	2 46	2 38	2 33	2 30	2 28	2 28	2 29	2 31	2 33	2 35	2 38
22	4 8	3 44	3 28	3 13	3 2	2 55	2 49	2 40	2 35	2 31	2 29	2 28	2 29	2 30	2 32	2 34	2 36
23	4 16	3 51	3 33	3 18	3 7	2 59	2 52	2 43	2 37	2 33	2 30	2 28	2 28	2 29	2 31	2 33	2 35
24	4 24	3 57	3 39	3 23	3 11	3 2	2 55	2 45	2 38	2 34	2 31	2 29	2 28	2 29	2 30	2 32	2 34
25	4 32	4 4	3 45	3 28	3 16	3 6	2 59	2 47	2 40	2 35	2 32	2 30	2 28	2 28	2 29	2 31	2 33
26	4 39	4 11	3 50	3 32	3 20	3 10	3 2	2 49	2 42	2 37	2 33	2 31	2 29	2 28	2 29	2 31	2 32
27	4 47	4 18	3 56	3 38	3 25	3 14	3 5	2 52	2 44	2 38	2 34	2 32	2 30	2 29	2 29	2 30	2 31
28	4 55	4 24	4 2	3 43	3 29	3 18	3 9	2 54	2 46	2 40	2 36	2 33	2 31	2 29	2 29	2 30	2 31
29	5 3	4 30	4 8	3 48	3 34	3 22	3 12	2 57	2 48	2 41	2 37	2 34	2 32	2 30	2 29	2 30	2 30
30	5 11	4 37	4 14	3 53	3 38	3 26	3 16	3 0	2 50	2 43	2 39	2 35	2 32	2 30	2 29	2 29	2 30
31	5 19	4 44	4 20	3 58	3 42	3 30	3 19	3 3	2 52	2 44	2 40	2 36	2 33	2 31	2 30	2 29	2 30
32	5 26	4 51	4 26	4 3	3 46	3 34	3 22	3 5	2 54	2 46	2 41	2 37	2 34	2 32	2 31	2 30	2 30
33	5 34	4 58	4 31	4 8	3 51	3 38	3 26	3 8	2 56	2 48	2 42	2 38	2 35	2 33	2 31	2 30	2 30
34	5 41	5 4	4 36	4 13	3 55	3 41	3 30	3 11	2 59	2 50	2 44	2 39	2 36	2 34	2 32	2 31	2 30
35	5 49	5 11	4 42	4 18	4 0	3 45	3 33	3 14	3 1	2 52	2 45	2 40	2 37	2 35	2 33	2 32	2 31
36	5 56	5 17	4 48	4 23	4 4	3 49	3 36	3 17	3 3	2 54	2 47	2 42	2 38	2 36	2 34	2 32	2 31
37	6 3	5 23	4 53	4 27	4 8	3 53	3 40	3 20	3 6	2 56	2 49	2 43	2 39	2 36	2 34	2 32	2 32
38	6 10	5 29	4 58	4 32	4 13	3 57	3 44	3 23	3 9	2 58	2 51	2 45	2 40	2 37	2 35	2 33	2 32
39	6 17	5 35	5 3	4 37	4 17	4 1	3 47	3 26	3 11	3 0	2 52	2 46	2 41	2 38	2 36	2 34	2 33
40	6 23	5 40	5 8	4 42	4 21	4 5	3 51	3 29	3 14	3 2	2 54	2 48	2 43	2 39	2 37	2 35	2 33
41	6 30	5 46	5 13	4 47	4 26	4 9	3 55	3 32	3 16	3 4	2 56	2 49	2 44	2 40	2 37	2 35	2 34
42	6 37	5 51	5 18	4 51	4 30	4 12	3 59	3 35	3 18	3 6	2 57	2 50	2 45	2 41	2 38	2 36	2 34
43	6 44	5 57	5 23	4 56	4 34	4 16	4 2	3 38	3 21	3 8	2 59	2 52	2 46	2 42	2 39	2 36	
44	6 51	6 3	5 28	5 0	4 38	4 19	4 5	3 41	3 23	3 10	3 0	2 53	2 47	2 43	2 40	2 37	
46	7 4	6 14	5 38	5 9	4 46	4 27	4 12	3 46	3 27	3 14	3 4	2 56	2 50	2 45	2 41		
48	7 16	6 24	5 48	5 17	4 53	4 34	4 18	3 51	3 32	3 18	3 7	2 59	2 53	2 47			
50	7 28	6 35	5 57	5 25	5 0	4 40	4 24	3 56	3 36	3 22	3 10	3 2	2 55				
52	7 39	6 45	6 6	5 33	5 7	4 46	4 30	4 0	3 40	3 26	3 13	3 4					
54	7 50	6 55	6 14	5 40	5 14	4 52	4 35	4 5	3 44	3 29	3 15						
56	8 0	7 4	6 22	5 47	5 20	4 58	4 40	4 9	3 48	3 32							
58	8 10	7 12	6 30	5 54	5 26	5 4	4 45	4 13	3 52								
60	8 19	7 21	6 37	6 0	5 32	5 9	4 49	4 17									
62	8 28	7 28	6 43	6 6	5 37	5 13	4 53										
64	8 36	7 35	6 49	6 12	5 43												
66	8 44	7 39	6 53														
68	8 51																
70																	
72																	
74																	
76																	
78																	
80																	
82																	
84																	
86																	
	6°	7°	8°	9°	10°	11°	12°	14°	16°	18°	20°	22°	24°	26°	28°	30°	32°

TABLE 36.

Apparent Distance, 106°

Apparent Altitude of the Sun or Star.

34°	36°	38°	40°	42°	44°	46°	50°	54°	58°	62°	66°	70°	74°	78°	82°	86°	☾'s
′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	Alt.
5 38	5 52	6 7	6 21	6 36	6 49	7 2	7 26	7 48	8 8	8 27	8 44						6°
5 2	5 14	5 27	5 38	5 50	6 1	6 13	6 34	6 54	7 12	7 27	7 40						7
4 34	4 45	4 56	5 6	5 16	5 26	5 36	5 55	6 14	6 29	6 42	6 53						8
4 11	4 21	4 31	4 41	4 50	4 59	5 7	5 23	5 38	5 53	6 3							9
3 54	4 3	4 12	4 21	4 29	4 37	4 45	4 59	5 13	5 25	5 37							10
3 40	3 48	3 56	4 4	4 11	4 18	4 26	4 39	4 51	5 3	5 13							11
3 28	3 35	3 42	3 50	3 57	4 4	4 11	4 23	4 35	4 45	4 53							12
3 18	3 25	3 31	3 38	3 45	3 51	3 57	4 8	4 19	4 28								13
3 10	3 16	3 22	3 28	3 34	3 40	3 45	3 56	4 5	4 14								14
3 3	3 9	3 14	3 20	3 25	3 30	3 35	3 45	3 54	4 2								15
2 58	3 3	3 8	3 13	3 17	3 22	3 27	3 36	3 44	3 51								16
2 53	2 58	3 2	3 7	3 11	3 15	3 20	3 28	3 36									17
2 49	2 54	2 58	3 2	3 6	3 9	3 14	3 21	3 28									18
2 46	2 50	2 54	2 58	3 1	3 4	3 8	3 15	3 22									19
2 43	2 47	2 50	2 54	2 57	3 0	3 3	3 10	3 16									20
2 41	2 44	2 47	2 50	2 53	2 56	2 59	3 6										21
2 39	2 42	2 44	2 47	2 50	2 53	2 56	3 2										22
2 37	2 40	2 42	2 44	2 47	2 50	2 53	2 58										23
2 36	2 38	2 40	2 42	2 45	2 47	2 50	2 55										24
2 34	2 36	2 38	2 40	2 43	2 45	2 47											25
2 33	2 35	2 37	2 39	2 41	2 43	2 45											26
2 32	2 34	2 36	2 38	2 39	2 41	2 43											27
2 32	2 33	2 35	2 36	2 38	2 40	2 41											28
2 31	2 32	2 34	2 35	2 37	2 38												29
2 31	2 32	2 33	2 34	2 36	2 37												30
2 30	2 31	2 32	2 33	2 35													31
2 30	2 31	2 32	2 33	2 34													32
2 30	2 30	2 31	2 32														33
2 30	2 30	2 31	2 32														34
2 30	2 30	2 31															35
2 30	2 30	2 31															36
2 31	2 30																37
2 31	2 31																38
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																	84
																	86

TABLE 36.

Apparent Distance, 110°

Apparent Altitude of the Sun or Star.

☾'s Alt.	6°	7°	8°	9°	10°	11°	12°	14°	16°	18°	20°	22°	24°	26°	28°	30°	32°
	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″
6°	2 35	2 37	2 40	2 44	2 49	2 55	3 1	3 15	3 30	3 45	4 1	4 17	4 33	4 49	5 5	5 21	5 37
7	2 37	2 35	2 37	2 40	2 44	2 48	2 53	3 3	3 15	3 27	3 40	3 53	4 7	4 21	4 34	4 47	5 1
8	2 41	2 37	2 35	2 37	2 40	2 43	2 47	2 54	3 3	3 14	3 25	3 36	3 48	4 0	4 12	4 23	4 35
9	2 45	2 40	2 37	2 36	2 38	2 40	2 43	2 48	2 55	3 3	3 13	3 23	3 34	3 44	3 54	4 4	4 14
10	2 51	2 44	2 40	2 38	2 36	2 38	2 40	2 44	2 49	2 56	3 4	3 13	3 22	3 31	3 40	3 49	3 58
11	2 57	2 49	2 43	2 40	2 38	2 37	2 38	2 41	2 45	2 51	2 58	3 5	3 13	3 21	3 29	3 37	3 45
12	3 4	2 54	2 47	2 43	2 40	2 38	2 37	2 39	2 43	2 47	2 53	2 59	3 6	3 13	3 20	3 27	3 34
13	3 11	2 59	2 51	2 46	2 42	2 40	2 38	2 38	2 41	2 44	2 49	2 54	3 0	3 6	3 12	3 18	3 24
14	3 18	3 4	2 55	2 49	2 45	2 42	2 40	2 38	2 39	2 42	2 46	2 50	2 55	3 0	3 5	3 11	3 16
15	3 25	3 10	3 0	2 53	2 48	2 44	2 42	2 39	2 39	2 41	2 44	2 47	2 51	2 55	3 0	3 5	3 10
16	3 33	3 16	3 5	2 57	2 51	2 46	2 43	2 40	2 38	2 40	2 42	2 45	2 48	2 51	2 56	3 0	3 4
17	3 41	3 23	3 10	3 1	2 54	2 49	2 46	2 42	2 39	2 39	2 40	2 43	2 45	2 48	2 52	2 56	3 0
18	3 49	3 29	3 15	3 5	2 57	2 52	2 48	2 43	2 40	2 38	2 39	2 41	2 43	2 46	2 49	2 53	2 57
19	3 56	3 36	3 21	3 10	3 1	2 55	2 51	2 45	2 41	2 39	2 38	2 40	2 42	2 44	2 47	2 50	2 54
20	4 4	3 42	3 27	3 15	3 5	2 58	2 53	2 47	2 43	2 40	2 38	2 39	2 41	2 43	2 45	2 48	2 51
21	4 12	3 49	3 33	3 19	3 9	3 2	2 56	2 49	2 44	2 41	2 39	2 39	2 40	2 42	2 44	2 46	2 49
22	4 20	3 56	3 39	3 24	3 14	3 5	3 0	2 51	2 46	2 42	2 40	2 39	2 40	2 41	2 43	2 45	2 47
23	4 28	4 3	3 45	3 29	3 18	3 9	3 3	2 53	2 47	2 43	2 41	2 39	2 39	2 40	2 42	2 44	2 46
24	4 36	4 9	3 51	3 34	3 22	3 13	3 6	2 55	2 49	2 44	2 42	2 40	2 39	2 40	2 41	2 43	2 45
25	4 45	4 16	3 57	3 40	3 27	3 17	3 9	2 58	2 50	2 46	2 43	2 41	2 39	2 39	2 40	2 42	2 44
26	4 53	4 23	4 3	3 45	3 32	3 21	3 13	3 0	2 52	2 47	2 44	2 42	2 40	2 39	2 40	2 41	2 43
27	5 1	4 31	4 9	3 50	3 36	3 25	3 16	3 3	2 54	2 49	2 45	2 43	2 40	2 40	2 39	2 40	2 42
28	5 9	4 37	4 15	3 55	3 41	3 30	3 20	3 5	2 57	2 51	2 47	2 44	2 41	2 40	2 39	2 40	2 41
29	5 17	4 44	4 21	4 0	3 46	3 34	3 24	3 8	2 59	2 52	2 48	2 45	2 42	2 41	2 40	2 40	2 41
30	5 25	4 50	4 27	4 5	3 50	3 38	3 28	3 11	3 1	2 54	2 50	2 46	2 43	2 41	2 40	2 40	2 41
31	5 33	4 57	4 33	4 10	3 55	3 42	3 32	3 14	3 3	2 56	2 51	2 47	2 44	2 42	2 41	2 40	2 41
32	5 40	5 4	4 39	4 15	3 59	3 47	3 35	3 17	3 6	2 58	2 52	2 48	2 45	2 43	2 42	2 41	2 41
33	5 48	5 11	4 44	4 21	4 4	3 51	3 39	3 20	3 8	3 0	2 54	2 49	2 46	2 44	2 42	2 41	2 41
34	5 56	5 17	4 49	4 26	4 8	3 54	3 43	3 23	3 11	3 2	2 56	2 51	2 47	2 45	2 43	2 42	2 42
35	6 3	5 24	4 55	4 31	4 13	3 58	3 46	3 26	3 13	3 4	2 57	2 52	2 49	2 46	2 44	2 43	2 42
36	6 11	5 30	5 1	4 36	4 17	4 2	3 49	3 29	3 15	3 6	2 59	2 54	2 50	2 47	2 45	2 43	2 43
37	6 18	5 37	5 6	4 41	4 21	4 6	3 53	3 32	3 18	3 8	3 1	2 55	2 51	2 48	2 46	2 44	2 43
38	6 25	5 43	5 11	4 46	4 26	4 10	3 57	3 35	3 20	3 10	3 3	2 57	2 52	2 49	2 47	2 45	2 44
39	6 32	5 49	5 17	4 51	4 30	4 14	4 1	3 38	3 23	3 12	3 4	2 58	2 53	2 50	2 48	2 46	
40	6 39	5 55	5 22	4 56	4 34	4 18	4 4	3 41	3 26	3 14	3 6	3 0	2 55	2 51	2 49	2 47	
41	6 46	6 1	5 27	5 1	4 39	4 21	4 8	3 44	3 28	3 16	3 7	3 1	2 56	2 52	2 49		
42	6 53	6 6	5 32	5 5	4 43	4 25	4 11	3 47	3 31	3 18	3 9	3 3	2 57	2 53	2 50		
43	7 0	6 12	5 38	5 10	4 47	4 29	4 15	3 50	3 33	3 20	3 11	3 4	2 58	2 54			
44	7 7	6 18	5 43	5 15	4 51	4 33	4 18	3 53	3 35	3 22	3 12	3 5	2 59	2 55			
46	7 20	6 30	5 54	5 24	5 0	4 40	4 25	3 58	3 40	3 26	3 16	3 8	3 4				
48	7 33	6 40	6 4	5 32	5 8	4 48	4 31	4 4	3 45	3 31	3 19	3 11					
50	7 45	6 50	6 13	5 40	5 15	4 54	4 37	4 9	3 50	3 35	3 23						
52	7 57	7 0	6 21	5 48	5 22	5 0	4 43	4 14	3 54	3 39							
54	8 8	7 10	6 30	5 56	5 29	5 7	4 49	4 19	3 57								
56	8 19	7 19	6 38	6 3	5 35	5 13	4 54	4 23									
58	8 29	7 29	6 46	6 10	5 41	5 19	4 59										
60	8 39	7 38	6 53	6 16	5 47												
62	8 47	7 46	6 59														
64	8 55																
66																	
68																	
70																	
72																	
74																	
76																	
78																	
80																	
82																	
84																	
86																	
	6°	7°	8°	9°	10°	11°	12°	14°	16°	18°	20°	22°	24°	26°	28°	30°	32°

TABLE 36.

Apparent Distance, 110°

Apparent Altitude of the Sun or Star.

34°	36°	38°	40°	42°	44°	46°	50°	54°	58°	62°	66°	70°	74°	78°	82°	86°	☾'s
′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	Alt.
5 52	6 8	6 23	6 37	6 52	7 6	7 19	7 43	8 7	8 28	8 46							6°
5 14	5 27	5 40	5 53	6 5	6 17	6 29	6 51	7 11	7 29	7 45							7
4 47	4 58	5 9	5 20	5 30	5 41	5 52	6 12	6 30	6 46	6 59							8
4 25	4 35	4 45	4 54	5 4	5 13	5 23	5 39	5 54	6 9								9
4 7	4 16	4 25	4 33	4 42	4 51	4 59	5 14	5 29	5 41								10
3 53	4 1	4 9	4 16	4 24	4 32	4 40	4 54	5 6	5 17								11
3 41	3 48	3 55	4 2	4 10	4 17	4 24	4 37	4 49	4 58								12
3 31	3 37	3 43	3 51	3 57	4 4	4 10	4 22	4 33									13
3 22	3 28	3 34	3 40	3 46	3 52	3 59	4 10	4 19									14
3 14	3 20	3 26	3 31	3 37	3 43	3 49	3 59	4 7									15
3 9	3 14	3 19	3 24	3 30	3 35	3 40	3 50	3 57									16
3 4	3 9	3 13	3 18	3 23	3 28	3 33	3 42										17
3 0	3 5	3 9	3 13	3 18	3 22	3 27	3 35										18
2 57	3 1	3 5	3 9	3 13	3 17	3 21	3 28										19
2 55	2 58	3 2	3 5	3 9	3 13	3 16	3 22										20
2 52	2 56	2 59	3 2	3 5	3 9	3 12											21
2 50	2 54	2 56	2 59	3 2	3 5	3 8											22
2 49	2 52	2 54	2 56	2 59	3 2	3 5											23
2 47	2 50	2 52	2 54	2 57	3 0	3 2											24
2 46	2 48	2 50	2 52	2 55	2 57												25
2 45	2 47	2 49	2 51	2 53	2 55												26
2 44	2 46	2 48	2 50	2 51													27
2 43	2 45	2 47	2 48	2 50													28
2 42	2 44	2 46	2 47														29
2 42	2 43	2 45	2 46														30
2 42	2 43	2 44															31
2 42	2 43	2 44															32
2 42	2 42																33
2 42	2 42																34
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																	84
																	86
34°	36°	38°	40°	42°	44°	46°	50°	54°	58°	62°	66°	70°	74°	78°	82°	86°	

Apparent Distance, 114°

Apparent Altitude of the Sun or Star.

☾'s Alt.	6°	7°	8°	9°	10°	11°	12°	14°	16°	18°	20°	22°	24°	26°	28°	30°	32°	☽'s Alt.
	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	
6°	2 45	2 47	2 50	2 54	2 59	3 5	3 12	3 27	3 42	3 58	4 15	4 31	4 48	5 4	5 21	5 37	5 53	6°
7	2 47	2 45	2 47	2 50	2 53	2 57	3 3	3 13	3 26	3 39	3 53	4 6	4 20	4 34	4 48	5 2	5 16	7
8	2 51	2 47	2 45	2 47	2 49	2 52	2 56	3 5	3 15	3 25	3 37	3 49	4 1	4 13	4 25	4 37	4 50	8
9	2 56	2 50	2 47	2 45	2 47	2 49	2 52	2 59	3 7	3 15	3 25	3 35	3 46	3 57	4 7	4 18	4 29	9
10	3 2	2 54	2 50	2 47	2 46	2 47	2 49	2 54	3 1	3 8	3 16	3 25	3 34	3 43	3 53	4 3	4 12	10
11	3 8	2 59	2 53	2 49	2 47	2 46	2 48	2 51	2 56	3 2	3 9	3 17	3 25	3 33	3 41	3 50	3 59	11
12	3 14	3 4	2 57	2 52	2 49	2 48	2 47	2 49	2 53	2 58	3 4	3 10	3 17	3 24	3 32	3 40	3 47	12
13	3 21	3 9	3 1	2 56	2 52	2 50	2 48	2 48	2 51	2 55	3 0	3 5	3 11	3 17	3 24	3 31	3 37	13
14	3 29	3 15	3 5	2 59	2 55	2 52	2 50	2 47	2 50	2 53	2 57	3 1	3 6	3 12	3 18	3 23	3 30	14
15	3 37	3 21	3 10	3 3	2 58	2 54	2 52	2 48	2 49	2 51	2 54	2 58	3 2	3 7	3 12	3 18	3 23	15
16	3 45	3 27	3 15	3 7	3 1	2 57	2 54	2 50	2 48	2 50	2 52	2 55	2 59	3 3	3 8	3 13	3 18	16
17	3 53	3 34	3 21	3 11	3 5	3 0	2 56	2 51	2 49	2 49	2 51	2 53	2 57	3 0	3 5	3 9	3 13	17
18	4 1	3 41	3 26	3 16	3 8	3 3	2 59	2 53	2 50	2 49	2 50	2 52	2 55	2 58	3 2	3 6	3 10	18
19	4 9	3 47	3 32	3 21	3 12	3 6	3 2	2 55	2 51	2 50	2 49	2 51	2 54	2 56	3 0	3 3	3 7	19
20	4 17	3 54	3 38	3 26	3 16	3 9	3 4	2 57	2 53	2 50	2 49	2 51	2 53	2 55	2 58	3 1	3 4	20
21	4 26	4 1	3 44	3 31	3 21	3 13	3 7	2 59	2 54	2 51	2 50	2 50	2 52	2 54	2 57	2 59	3 2	21
22	4 34	4 8	3 50	3 36	3 26	3 17	3 11	3 1	2 56	2 53	2 51	2 50	2 51	2 53	2 56	2 58	3 0	22
23	4 42	4 15	3 57	3 42	3 30	3 21	3 14	3 4	2 58	2 54	2 52	2 51	2 51	2 53	2 55	2 57	2 59	23
24	4 50	4 22	4 3	3 47	3 35	3 25	3 17	3 7	3 0	2 55	2 53	2 51	2 50	2 52	2 54	2 56	2 58	24
25	4 59	4 29	4 9	3 53	3 40	3 30	3 21	3 9	3 2	2 57	2 54	2 52	2 51	2 51	2 53	2 55	2 57	25
26	5 7	4 36	4 15	3 58	3 45	3 34	3 25	3 11	3 4	2 59	2 55	2 53	2 52	2 51	2 52	2 54	2 56	26
27	5 15	4 43	4 21	4 3	3 49	3 38	3 28	3 14	3 6	3 1	2 57	2 55	2 52	2 52	2 52	2 53	2 55	27
28	5 23	4 50	4 27	4 9	3 54	3 42	3 32	3 17	3 8	3 2	2 58	2 56	2 53	2 52	2 52	2 53	2 54	28
29	5 31	4 57	4 33	4 14	3 59	3 47	3 37	3 20	3 11	3 4	3 0	2 57	2 54	2 53	2 52	2 53	2 54	29
30	5 39	5 4	4 39	4 19	4 2	3 51	3 41	3 23	3 13	3 6	3 1	2 58	2 55	2 54	2 53	2 53	2 54	30
31	5 47	5 11	4 45	4 24	4 8	3 55	3 45	3 27	3 15	3 8	3 3	2 59	2 56	2 55	2 54	2 53	2 54	31
32	5 55	5 18	4 51	4 29	4 13	4 0	3 49	3 30	3 18	3 10	3 5	3 1	2 58	2 56	2 54	2 53	2 54	32
33	6 4	5 25	4 58	4 35	4 18	4 4	3 52	3 33	3 20	3 12	3 6	3 2	2 59	2 57	2 55	2 54	2 53	33
34	6 12	5 32	5 3	4 40	4 23	4 8	3 56	3 36	3 23	3 14	3 8	3 3	3 0	2 58	2 56	2 55	2 52	34
35	6 20	5 39	5 9	4 45	4 28	4 13	3 59	3 39	3 26	3 17	3 10	3 5	3 2	2 59	2 57	2 56		35
36	6 28	5 46	5 15	4 50	4 32	4 17	4 3	3 42	3 28	3 19	3 12	3 7	3 3	3 0	2 58	2 57		36
37	6 35	5 53	5 21	4 56	4 37	4 21	4 7	3 45	3 31	3 21	3 14	3 8	3 4	3 1	2 59			37
38	6 43	5 59	5 26	5 1	4 41	4 25	4 11	3 49	3 34	3 23	3 16	3 10	3 5	3 2	3 0			38
39	6 51	6 6	5 32	5 6	4 45	4 29	4 15	3 52	3 37	3 25	3 17	3 11	3 7	3 3				39
40	6 58	6 12	5 38	5 11	4 49	4 33	4 18	3 55	3 39	3 28	3 19	3 13	3 8	3 4				40
41	7 5	6 18	5 44	5 16	4 51	4 36	4 22	3 58	3 42	3 30	3 21	3 14	3 9					41
42	7 12	6 24	5 49	5 21	4 58	4 40	4 25	4 1	3 45	3 33	3 23	3 15	3 11					42
43	7 19	6 30	5 55	5 26	5 2	4 44	4 29	4 4	3 47	3 35	3 25	3 17						43
44	7 26	6 36	6 0	5 31	5 7	4 48	4 33	4 7	3 50	3 37	3 37	3 19						44
46	7 40	6 48	6 11	5 41	5 16	4 56	4 39	4 13	3 55	3 41	3 30							46
48	7 54	6 59	6 21	5 50	5 24	5 4	4 46	4 19	4 0	3 45								48
50	8 6	7 9	6 30	5 58	5 32	5 11	4 52	4 25	4 5									50
52	8 18	7 20	6 39	6 6	5 39	5 17	4 58	4 30										52
54	8 30	7 30	6 48	6 14	5 46	5 24	5 4											54
56	8 42	7 40	6 57	6 22	5 53													56
58	8 51	7 50	7 6															58
60	9 1																	60
62																		62
64																		64
66																		66
68																		68
70																		70
72																		72
74																		74
76																		76
78																		78
80																		80
82																		82
84																		84

TABLE 36.

APPARENT DISTANCE, 114°

Apparent Altitude of the Sun or Star.

34°	36°	38°	40°	42°	44°	46°	50°	54°	58°	62°	66°	70°	74°	78°	82°	86°	☾ A
′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	
6 9	6 26	6 41	6 56	7 11	7 25	7 39	8 5	8 30	8 52								
5 30	5 44	5 58	6 11	6 23	6 35	6 47	7 10	7 31	7 52								
5 2	5 14	5 26	5 37	5 48	5 58	6 9	6 29	6 48	7 7								8
4 39	4 50	5 0	5 10	5 20	5 30	5 40	5 58	6 14									9
4 21	4 31	4 40	4 49	4 58	5 7	5 16	5 32	5 47									10
4 7	4 15	4 24	4 32	4 40	4 48	4 56	5 10	5 24									11
3 55	4 2	4 10	4 17	4 25	4 32	4 39	4 52	5 5									12
3 45	3 52	3 58	4 6	4 12	4 18	4 25	4 37										13
3 36	3 43	3 49	3 55	4 1	4 7	4 13	4 25										14
3 29	3 35	3 41	3 47	3 52	3 58	4 3	4 14										15
3 23	3 29	3 34	3 39	3 45	3 50	3 54	4 2										16
3 18	3 23	3 28	3 33	3 38	3 43	3 47											17
3 14	3 19	3 23	3 28	3 32	3 37	3 41											18
3 11	3 15	3 19	3 23	3 27	3 31	3 35											19
3 8	3 12	3 15	3 19	3 23	3 27	3 31											20
3 5	3 9	3 12	3 16	3 19	3 22												21
3 3	3 7	3 10	3 13	3 16	3 19												22
3 2	3 5	3 8	3 10	3 13													23
3 0	3 3	3 6	3 8	3 10													24
2 59	3 1	3 4	3 7														25
2 58	3 0	3 2	3 5														26
2 57	2 59	3 1															27
2 56	2 58	3 0															28
2 55	2 57																29
2 55	2 56																30
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																	82
																	84
																	86
34°	36°	38°	40°	42°	44°	46°	50°	54°	58°	62°	66°	70°	74°	78°	82°	86°	

TABLE 36.

APPARENT DISTANCE, 118°

Apparent Altitude of the Sun or Star.

☾'s Alt.	6°	7°	8°	9°	10°	11°	12°	14°	16°	18°	20°	22°	24°	26°	28°	30°	32°	☾'s Alt.
	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	
6	2 55	2 57	3 0	3 5	3 10	3 17	3 24	3 40	3 56	4 12	4 30	4 48	5 5	5 22	5 39	5 56	6 13	6
7	2 57	2 57	2 58	3 1	3 4	3 9	3 15	3 26	3 39	3 53	4 7	4 22	4 36	4 51	5 5	5 20	5 35	7
8	3 1	2 58	2 56	2 58	3 1	3 4	3 8	3 17	3 28	3 39	3 51	4 4	4 16	4 29	4 42	4 54	5 7	8
9	3 6	3 1	2 58	2 57	2 59	3 1	3 4	3 11	3 19	3 28	3 39	3 50	4 1	4 12	4 23	4 34	4 46	9
10	3 12	3 5	3 1	2 59	2 58	2 59	3 1	3 7	3 13	3 31	3 30	3 39	3 49	3 58	4 8	4 18	4 23	10
11	3 19	3 10	3 5	3 1	2 59	2 58	2 59	3 4	3 9	3 15	3 23	3 30	3 39	3 47	3 56	4 5	4 14	11
12	3 26	3 16	3 9	3 4	3 1	2 59	2 58	3 2	3 6	3 11	3 17	3 23	3 31	3 33	3 46	3 54	4 2	12
13	3 34	3 21	3 13	3 8	3 4	3 1	2 59	3 0	3 4	3 8	3 13	3 18	3 24	3 31	3 38	3 45	3 52	13
14	3 42	3 27	3 18	3 12	3 7	3 4	3 1	2 59	3 2	3 5	3 10	3 14	3 19	3 25	3 31	3 38	3 44	14
15	3 50	3 34	3 23	3 16	3 11	3 7	3 4	3 0	3 1	3 4	3 7	3 11	3 15	3 21	3 26	3 32	3 38	15
16	3 58	3 40	3 28	3 20	3 14	3 10	3 6	3 2	3 0	3 2	3 5	3 8	3 12	3 17	3 22	3 28	3 33	16
17	4 6	3 47	3 34	3 24	3 18	3 13	3 8	3 3	3 1	3 2	3 4	3 6	3 10	3 14	3 19	3 24	3 28	17
18	4 15	3 55	3 40	3 29	3 21	3 16	3 11	3 5	3 2	3 1	3 3	3 5	3 8	3 12	3 16	3 20	3 24	18
19	4 24	4 2	3 46	3 34	3 25	3 19	3 14	3 8	3 3	3 2	3 2	3 4	3 7	3 10	3 14	3 17	3 21	19
20	4 32	4 9	3 53	3 40	3 30	3 23	3 17	3 10	3 5	3 3	3 2	3 4	3 6	3 9	3 12	3 15	3 19	20
21	4 41	4 16	3 59	3 45	3 34	3 27	3 21	3 12	3 7	3 4	3 3	3 4	3 6	3 8	3 10	3 13	3 16	21
22	4 49	4 23	4 5	3 50	3 39	3 31	3 24	3 14	3 9	3 6	3 4	3 3	3 5	3 7	3 9	3 12	3 14	22
23	4 48	4 30	4 12	3 56	3 44	3 35	3 28	3 17	3 11	3 7	3 5	3 4	3 5	3 6	3 8	3 11	3 13	23
24	5 7	4 37	4 18	4 2	3 49	3 39	3 31	3 20	3 13	3 9	3 6	3 5	3 4	3 6	3 8	3 10	3 12	24
25	5 15	4 44	4 24	4 7	3 54	3 44	3 35	3 23	3 16	3 11	3 8	3 6	3 5	3 6	3 7	3 9	3 11	25
26	5 24	4 52	4 31	4 12	3 59	3 48	3 39	3 28	3 18	3 13	3 9	3 7	3 6	3 6	3 7	3 9	3 11	26
27	5 31	4 59	4 37	4 18	4 4	3 53	3 43	3 29	3 20	3 15	3 11	3 9	3 7	3 6	3 7	3 8	3 10	27
28	5 41	5 6	4 43	4 23	4 9	3 57	3 47	3 32	3 22	3 16	3 12	3 10	3 8	3 6	3 7	3 8	3 10	28
29	5 49	5 14	4 50	4 29	4 14	4 2	3 51	3 35	3 25	3 18	3 14	3 11	3 9	3 7	3 7	3 8	3 9	29
30	5 57	5 21	4 56	4 34	4 18	4 6	3 55	3 38	3 27	3 20	3 15	3 12	3 10	3 8	3 8	3 8	3 7	30
31	6 6	5 28	5 2	4 40	4 23	4 10	3 59	3 41	3 30	3 22	3 17	3 13	3 11	3 9	3 9	3 8		31
32	6 14	5 36	5 8	4 45	4 28	4 14	4 3	3 44	3 33	3 24	3 19	3 15	3 12	3 10	3 10	3 8		32
33	6 23	5 43	5 15	4 51	4 33	4 19	4 7	3 48	3 35	3 27	3 21	3 16	3 13	3 11	3 10			33
34	6 31	5 51	5 21	4 55	4 38	4 23	4 10	3 51	3 38	3 29	3 23	3 18	3 14	3 12	3 11			34
35	6 40	5 58	5 27	5 2	4 43	4 28	4 15	3 54	3 41	3 32	3 25	3 20	3 15	3 12				35
36	6 48	6 5	5 33	5 8	4 48	4 33	4 19	3 57	3 44	3 34	3 27	3 22	3 18	3 14				36
37	6 56	6 12	5 39	5 13	4 53	4 37	4 23	4 1	3 47	3 37	3 29	3 23	3 20					37
38	7 4	6 19	5 45	5 18	4 58	4 41	4 27	4 5	3 50	3 39	3 31	3 25	3 20					38
39	7 12	6 26	5 51	5 24	5 3	4 46	4 31	4 8	3 53	3 41	3 33	3 26						39
40	7 20	6 33	5 57	5 29	5 7	4 50	4 35	4 11	3 55	3 44	3 35	3 27						40
41	7 27	6 39	6 3	5 34	5 12	4 54	4 39	4 15	3 58	3 47	3 37							41
42	7 34	6 45	6 8	5 40	5 17	4 58	4 41	4 18	4 1	3 49	3 30							42
43	7 42	6 51	6 14	5 45	5 22	5 3	4 46	4 21	4 4	3 51								43
44	7 50	6 58	6 20	5 50	5 26	5 7	4 50	4 24	4 7	3 55								44
46	8 5	7 10	6 30	5 59	5 35	5 15	4 58	4 30	4 10									45
48	8 19	7 21	6 41	6 9	5 44	5 23	5 4	4 36										48
50	8 31	7 32	6 51	6 19	5 52	5 31	5 12											50
52	8 43	7 44	7 1	6 30	6 0													52
54	8 55	7 56	7 12															54
56	9 7																	56
58																		58
60																		60
62																		62
64																		64
66																		66
68																		68
70																		70
72																		72
74																		74
76																		76
78																		78
80																		80
82																		82
84																		84

TABLE 36.

APPARENT DISTANCE, 118°

Apparent Altitude of the Sun or Star.

34°	36°	38°	40°	42°	44°	46°	50°	54°	58°	62°	66°	70°	74°	78°	82°	86°	☽'s Alt.
′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	
6 30	6 47	7 3	7 18	7 34	7 49	8 4	8 31	8 55									6°
5 50	6 5	6 19	6 32	6 45	6 57	7 9	7 32	7 55									7
5 20	5 33	5 46	5 57	6 9	6 19	6 30	6 50	7 10									8
4 57	5 8	5 18	5 28	5 39	5 49	5 59	6 18										9
4 38	4 48	4 57	5 7	5 17	5 26	5 35	5 52										10
4 23	4 32	4 41	4 50	4 58	5 7	5 15	5 23										11
4 10	4 19	4 27	4 35	4 43	4 50	4 57	5 4										12
4 0	4 8	4 14	4 22	4 29	4 36	4 43											13
3 51	3 58	4 5	4 12	4 18	4 25	4 30											14
3 44	3 50	3 56	4 3	4 9	4 15	4 21											15
3 38	3 44	3 50	3 55	4 1	4 7	4 13											16
3 33	3 39	3 44	3 49	3 54	3 59												17
3 29	3 34	3 39	3 44	3 48	3 52												18
3 25	3 30	3 35	3 39	3 43													19
3 23	3 27	3 31	3 35	3 39													20
3 20	3 24	3 28	3 32														21
3 18	3 21	3 25	3 29														22
3 16	3 19	3 23															23
3 15	3 19	3 22															24
3 14	3 17																25
3 13	3 15																26
3 12																	27
3 11																	28
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																	82
																	84
																	86
34°	36°	38°	40°	42°	44°	46°	50°	54°	58°	62°	66°	70°	74°	78°	82°	86°	

APPARENT DISTANCE, 120°

Apparent Altitude of the Sun or Star.

☾'s Alt.	6°	7°	8°	9°	10°	11°	12°	14°	16°	18°	20°	22°	24°	26°	28°	30°	32°	☾ A
	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	
6°	3 1	3 3	3 6	3 11	3 17	3 24	3 32	3 47	4 4	4 21	4 39	4 57	5 15	5 32	5 49	6 6	6 23	6
7	3 3	3 2	3 4	3 7	3 11	3 16	3 22	3 34	3 47	4 1	4 15	4 30	4 45	5 0	5 15	5 30	5 45	
8	3 7	3 4	3 3	3 5	3 8	3 11	3 15	3 25	3 35	3 46	3 59	4 12	4 25	4 38	4 51	5 4	5 17	
9	3 12	3 8	3 5	3 4	3 6	3 8	3 11	3 18	3 26	3 36	3 47	3 58	4 9	4 20	4 31	4 43	4 55	
10	3 18	3 12	3 8	3 6	3 5	3 6	3 8	3 14	3 20	3 28	3 38	3 47	3 57	4 7	4 17	4 27	4 37	10
11	3 25	3 17	3 12	3 8	3 6	3 5	3 6	3 11	3 16	3 22	3 30	3 38	3 47	3 56	4 5	4 14	4 23	11
12	3 33	3 23	3 16	3 11	3 8	3 6	3 5	3 9	3 13	3 18	3 24	3 31	3 39	3 47	3 55	4 3	4 11	12
13	3 41	3 28	3 20	3 15	3 11	3 8	3 6	3 8	3 11	3 15	3 20	3 26	3 32	3 39	3 46	3 53	4 0	13
14	3 40	3 34	3 25	3 19	3 14	3 11	3 8	3 7	3 9	3 12	3 17	3 22	3 27	3 33	3 39	3 46	3 52	14
15	3 57	3 41	3 30	3 23	3 18	3 14	3 11	3 8	3 8	3 11	3 14	3 18	3 24	3 29	3 34	3 40	3 46	15
16	4 6	3 48	3 36	3 28	3 22	3 17	3 13	3 9	3 8	3 10	3 12	3 16	3 20	3 25	3 30	3 36	3 41	16
17	4 14	3 55	3 42	3 32	3 25	3 20	3 15	3 10	3 9	3 9	3 11	3 14	3 18	3 22	3 27	3 32	3 36	17
18	4 23	4 3	3 48	3 37	3 29	3 23	3 18	3 12	3 10	3 9	3 11	3 13	3 16	3 20	3 24	3 28	3 32	18
19	4 32	4 10	3 54	3 42	3 33	3 26	3 21	3 15	3 11	3 10	3 10	3 12	3 15	3 18	3 21	3 25	3 29	19
20	4 40	4 17	4 1	3 48	3 38	3 30	3 24	3 17	3 13	3 11	3 10	3 12	3 14	3 16	3 19	3 23	3 27	20
21	4 49	4 24	4 7	3 53	3 42	3 34	3 28	3 19	3 15	3 12	3 10	3 11	3 13	3 15	3 17	3 21	3 24	21
22	4 58	4 31	4 14	3 58	3 47	3 39	3 32	3 22	3 16	3 18	3 11	3 11	3 12	3 14	3 16	3 19	3 22	22
23	5 7	4 39	4 21	4 4	3 52	3 43	3 36	3 25	3 18	3 14	3 12	3 12	3 12	3 13	3 15	3 18	3 21	23
24	5 16	4 46	4 27	4 10	3 57	3 47	3 39	3 28	3 20	3 16	3 14	3 13	3 13	3 13	3 15	3 17	3 20	24
25	5 25	4 53	4 83	4 15	4 2	3 51	3 43	3 31	3 23	3 18	3 15	3 14	3 13	3 13	3 15	3 17	3 19	25
26	5 34	5 1	4 40	4 20	4 7	3 56	3 47	3 34	3 25	3 20	3 16	3 15	3 13	3 14	3 15	3 16	3 18	26
27	5 42	5 8	4 47	4 25	4 12	4 1	3 51	3 37	3 28	3 22	3 18	3 16	3 14	3 14	3 15	3 16	3 18	27
28	5 51	5 16	4 53	4 31	4 17	4 5	3 54	3 40	3 30	3 24	3 20	3 17	3 15	3 14	3 15	3 16	3 18	28
29	6 0	5 24	5 0	4 37	4 22	4 10	3 59	3 43	3 33	3 26	3 21	3 18	3 16	3 15	3 15	3 16		29
30	6 8	5 31	5 6	4 43	4 27	4 15	4 3	3 46	3 36	3 28	3 23	3 19	3 17	3 16	3 16	3 16		30
31	6 17	5 39	5 12	4 48	4 32	4 19	4 7	3 49	3 38	3 30	3 25	3 20	3 18	3 17	3 17			31
32	6 25	5 46	5 18	4 54	4 37	4 23	4 11	3 52	3 41	3 32	3 27	3 22	3 19	3 18	3 18			32
33	6 34	5 54	5 25	5 0	4 42	4 27	4 15	3 56	3 44	3 35	3 29	3 24	3 21	3 19				33
34	6 43	6 2	5 31	5 6	4 47	4 32	4 19	3 59	3 47	3 37	3 31	3 26	3 22	3 20				34
35	6 51	6 9	5 38	5 12	4 52	4 37	4 24	4 2	3 50	3 40	3 33	3 28	3 24					35
36	6 59	6 16	5 44	5 18	4 57	4 42	4 28	4 5	3 53	3 42	3 35	3 30	3 26					36
37	7 8	6 23	5 50	5 23	5 2	4 46	4 32	4 9	3 56	3 45	3 37	3 31						37
38	7 16	6 30	5 56	5 28	5 7	4 50	4 36	4 13	3 59	3 47	3 39	3 33						38
39	7 24	6 37	6 2	5 34	5 12	4 55	4 40	4 16	4 1	3 50	3 41							39
40	7 32	6 44	6 8	5 39	5 17	4 59	4 44	4 20	4 4	3 52	3 43							40
41	7 40	6 50	6 14	5 44	5 22	5 4	4 48	4 24	4 7	3 55								41
42	7 47	6 56	6 19	5 50	5 27	5 8	4 52	4 28	4 10	3 57								42
43	7 55	7 2	6 25	5 55	5 32	5 13	4 56	4 31	4 13									43
44	8 3	7 9	6 31	6 0	5 37	5 17	5 0	4 34	4 16									44
46	8 18	7 21	6 41	6 10	5 46	5 26	5 8	4 40										46
48	8 32	7 33	6 52	6 20	5 55	5 34	5 14											48
50	8 45	7 45	7 2	6 30	6 3													50
52	8 57	7 57	7 13															52
54	9 9																	54
56																		56
58																		58
60																		60
62																		62
64																		64
66																		66
68																		68
70																		70
72																		72
74																		74
76																		76
78																		78
80																		80
82																		82
84																		84
86																		86

TABLE 36.

Apparent Distance, 120°

Apparent Altitude of the Sun or Star.

34°	36°	38°	40°	42°	44°	46°	50°	54°	58°	62°	66°	70°	74°	78°	82°	86°	☾'s
′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	Alt.
41	6 58	7 14	7 30	7 46	8 2	8 17	8 44	9 9									6°
0	6 15	6 29	6 43	6 56	7 8	7 21	7 45										7
30	5 43	5 56	6 8	6 20	6 31	6 42	7 3										8
7	5 18	5 28	5 38	5 49	6 0	6 10	6 29										9
47	4 57	5 7	5 17	5 27	5 37	5 46	6 3										10
32	4 42	4 51	4 59	5 8	5 17	5 25											11
19	4 28	4 37	4 44	4 52	5 0	5 7											12
8	4 16	4 24	4 31	4 38	4 46	4 53											13
59	4 6	4 13	4 20	4 27	4 34	4 40											14
52	3 58	4 4	4 11	4 18	4 24												15
46	3 52	3 58	4 4	4 10	4 16												16
41	3 47	3 52	3 58	4 3													17
37	3 42	3 47	3 52	3 57													18
33	3 38	3 43	3 47														19
31	3 35	3 39	3 44														20
28	3 32	3 36															21
27	3 29	3 33															22
24	3 27																23
23	3 26																24
21																	25
20																	26
																	27
																	28
																	29
																	30
																	31
																	32
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																	56
																	58
																	60
																	62
																	64
																	66
																	68
																	70
																	72
																	74
																	76
																	78
																	80
																	82
																	84
																	86
34°	36°	38°	40°	42°	44°	46°	50°	54°	58°	62°	66°	70°	74°	78°	82°	86°	

TABLE 37.

DISTANCE

	°	30°	35°	40°	45°	50°	55°	60°	65°	70°	75°	80°	85	90°
☽'s Altitude.	15	5″	4″	4″	3″	3″	3″	3″	3″	2″	2″	2″	2″	2″
	20	6	5	5	4	4	4	3	3	3	3	3	3	3
	25	7	6	6	5	5	5	4	4	4	4	4	4	4
	30	9	8	7	6	6	5	5	5	5	4	4	4	4
	35	10	9	8	7	7	6	6	5	5	5	5	5	5
	40	11	10	9	8	7	7	6	6	6	6	6	6	6
	45	12	11	10	9	8	8	7	6	7	6	6	6	6
	50	13	12	10	10	9	8	8	7	7	7	7	7	7
	55	14	13	11	10	9	9	8	7	8	8	7	7	7
	60	15	13	12	11	10	9	9	8	8	8	8	8	8
	65	16	14	12	11	10	10	9	8	8	8	8	8	8
	70	17	15	13	12	11	10	10	9	9	9	9	9	8
	75	17	15	13	12	11	10	10	9	9	9	9	9	9
	80	17	15	13	12	11	11	10	9	9	9	9	9	9
	85	18	16	14	12	11	11	10	10	9	9	9	9	9
	90	18	16	14	12	11	11	10	10	9	9	9	9	9
☉'s Altitude.	15	3	3	3	2	2	2	1	1	1	0	0	0	0
	20	4	4	4	3	2	2	2	1	1	1	0	0	0
	25	5	5	4	4	3	2	2	2	1	1	1	0	0
	30	6	6	5	4	4	3	2	2	2	1	1	0	0
	35	8	7	6	5	4	3	3	2	2	1	1	0	0
	40	9	8	7	6	5	4	3	3	2	2	1	0	0
	45	10	9	7	6	5	4	4	3	2	2	1	0	0
	50	11	10	8	7	6	5	4	3	2	2	1	1	0
	55	12	10	8	7	6	5	4	3	3	2	1	1	0
	60	13	11	9	8	6	5	4	4	3	2	1	1	0
	65	13	11	9	8	7	6	5	4	3	2	1	1	0
	70	14	12	10	8	7	6	5	4	3	2	1	1	0
	75	14	12	10	8	7	6	5	4	3	2	2	1	0
	80	15	13	10	9	7	6	5	4	3	2	2	1	0
	85	15	13	10	9	7	6	5	4	3	2	2	1	0
	90	15	13	11	9	7	6	5	4	3	2	2	1	0
								120°	115°	110°	105°	100°	95°	

Note. *The difference* of the two entries, taken from these two Tables, is the effect of the Sun's Parallax on the distance, the first Table with —, the second +, but when the distance is more than 90° both Tables take the Sign —

TABLE 38

Hor. Par. of Pla-nets.	Numbers from Table 37																	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
″																		
2	0	1	1	1	1	1	2	2	2	2	2	3	3	3	3	4	4	4
4	0	1	1	2	2	3	3	4	4	5	5	5	6	6	7	7	8	8
6	1	1	2	3	3	4	5	5	6	7	7	8	9	10	10	11	12	12
8	1	2	3	4	5	6	6	7	8	9	10	11	12	13	14	15	15	16
10	1	2	3	5	6	7	8	9	10	11	12	14	15	16	17	18	19	20
12	1	3	4	5	7	8	10	11	12	14	15	16	18	19	20	22	22	23
14	2	3	5	6	8	10	11	13	14	16	17	19	21	22	24	25	27	29
16	2	4	5	7	9	11	13	15	16	18	20	22	24	25	27	29	31	33
18	2	4	6	8	10	12	14	16	18	20	22	25	27	29	31	33	35	37
20	2	5	7	9	11	14	16	18	20	23	25	27	30	32	34	36	39	41
22	3	5	7	10	13	15	17	20	22	25	27	30	33	35	38	40	42	45
24	3	5	8	11	14	16	19	22	25	27	30	33	35	38	41	44	46	49
26	3	6	9	12	15	18	21	24	27	29	32	35	38	41	44	47	50	53
28	3	6	10	13	16	19	22	25	29	32	35	38	41	45	48	51	54	57
30	3	7	10	14	17	20	24	27	31	34	37	41	44	48	51	54	58	61

TABLE 39

Corrections to find Greenwich Time corresponding to a reduced Lunar Distance.

Approximate Interval.		Difference of the Proportional Logarithm in the Almanack.																
		2	6	10	14	18	22	26	30	40	50	60	70	80	90	100	110	120
h. m.	h. m.	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s
0 0	3 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	2 50	0	0	1	1	1	1	2	2	3	3	4	5	5	6	7	7	8
20	2 40	0	1	1	2	2	3	3	4	5	6	7	9	10	11	12	14	15
30	2 30	0	1	2	2	3	4	5	5	7	9	10	12	14	16	17	19	21
40	2 20	0	1	2	3	4	5	6	6	9	11	13	15	17	19	22	24	26
50	2 10	1	2	3	4	5	5	6	7	10	13	15	17	20	22	25	27	30
1 0	2 0	1	2	3	4	5	6	7	8	11	14	17	19	22	25	28	30	33
1 10	1 50	1	2	3	4	5	6	8	9	12	15	18	21	24	27	30	32	35
1 20	1 40	1	2	3	4	6	7	8	9	12	15	19	21	25	28	31	34	37
1 30	1 30	1	2	3	4	6	7	8	9	12	16	19	22	25	28	31	34	37

TABLE 40.

Horary Angles and Altitudes of the Sun or Star, by which the Time and Azimuth are obtained with the greatest accuracy.

Lat.	2°		4°		6°		8°		10°		12°		14°		16°		18°	
	H.Ang	Alt.	H.Ang	Alt.	H.Ang	Alt.	H.Ang	Alt.	H.Ang	Alt.	H.Ang	Alt.	H.Ang	Alt.	H.Ang	Alt.	H.Ang	Alt.
°	h m	°	h m	°	h m	°	h m	°	h m	°	h m	°	h m	°	h m	°	h m	°
1	4 0	30	5 2	14	5 22	10	5 31	7	5 37	6	5 41	5	5 44	4	5 46	4	5 48	3
2	0 0	90	4 0	30	4 42	19	5 2	15	5 14	12	5 22	10	5 28	8	5 32	7	5 35	6
3	3 13	42	2 46	49	4 0	30	4 32	22	4 51	18	5 3	15	5 11	12	5 18	11	5 23	10
4	4 0	30	0 0	90	3 13	42	4 1	30	4 27	24	4 43	20	4 55	17	5 4	15	5 10	13
5	4 26	24	2 28	53	2 15	56	3 26	39	4 1	30	4 23	25	4 38	21	4 49	18	4 58	16
6	4 42	20	3 13	42	0 0	90	2 46	49	3 34	37	4 1	30	4 20	26	4 34	22	4 45	20
7	4 54	17	3 41	35	2 5	59	1 56	61	3 3	45	3 38	36	4 2	30	4 19	26	4 31	23
8	5 2	15	4 1	30	2 46	49	0 0	90	2 29	53	3 14	42	3 43	35	4 3	30	4 17	27
9	5 9	12	4 15	26	3 14	42	1 50	63	1 44	64	2 47	49	3 22	40	3 46	34	4 3	30
10	5 14	11	4 27	24	3 34	37	2 29	53	0 0	90	2 16	57	3 0	46	3 28	39	3 49	34
11	5 19	10	4 36	22	3 49	33	2 55	47	1 40	66	1 35	67	2 35	52	3 9	44	3 33	38
12	5 22	10	4 43	20	4 1	30	3 14	42	2 16	59	0 0	90	2 6	59	2 49	49	3 17	42
13	5 25	9	4 49	18	4 12	28	3 30	38	2 14	51	1 32	68	1 29	68	2 26	55	2 59	47
14	5 28	8	4 55	17	4 20	26	3 43	35	3 0	46	2 6	59	0 0	90	1 58	61	2 40	52
15	5 30	8	4 59	16	4 28	24	3 53	33	3 15	42	2 30	53	1 26	69	1 23	70	2 18	57
16	5 32	7	5 4	15	4 34	22	4 3	30	3 28	39	2 49	49	1 58	61	0 0	90	1 52	63
17	5 34	7	5 7	14	4 40	21	4 11	28	3 39	36	3 4	45	2 21	56	1 21	71	1 19	71
18	5 35	6	5 10	13	4 45	20	4 17	27	3 49	34	3 17	42	2 40	52	1 52	63	0 0	90
19	5 37	6	5 13	12	4 49	19	4 24	25	3 57	32	3 28	40	2 54	48	2 14	58	1 17	72
20	5 38	6	5 16	12	4 53	18	4 29	24	4 4	31	3 37	37	3 7	45	2 34	54	1 47	65
21	5 39	6	5 18	11	4 56	17	4 34	23	4 11	29	3 36	35	3 18	42	2 47	50	2 9	60
22	5 40	5	5 20	11	5 0	16	4 39	22	4 16	28	3 53	34	3 28	40	2 59	47	2 26	56
23	5 41	5	5 22	10	5 3	16	4 43	21	4 22	26	4 0	32	3 36	38	3 10	45	2 40	52
24	5 42	5	5 24	10	5 5	15	4 46	20	4 27	25	4 6	31	3 44	36	3 20	43	2 53	49
25	5 43	5	5 26	9	5 8	14	4 50	19	4 31	24	4 12	29	3 51	35	3 28	41	3 3	47
26	5 44	5	5 27	9	5 10	14	4 53	19	4 35	23	4 17	28	3 57	33	3 36	39	3 13	45
27	5 44	4	5 28	9	5 12	13	4 56	18	4 39	22	4 21	27	4 3	32	3 43	37	3 22	43
28	5 45	4	5 30	9	5 14	13	4 59	17	4 43	22	4 26	26	4 8	31	3 49	36	3 29	41
29	5 46	4	5 31	8	5 16	12	5 1	17	4 46	21	4 30	25	4 13	30	3 55	35	3 36	40
30	5 46	4	5 32	8	5 18	12	5 4	16	4 49	20	4 34	25	4 18	29	4 1	34	3 43	38
31	5 47	4	5 33	8	5 20	12	5 6	16	4 52	20	4 37	24	4 22	28	4 6	33	3 49	37
32	5 47	4	5 34	8	5 21	11	5 8	15	4 54	19	4 40	23	4 26	27	4 11	32	3 55	36
33	5 48	4	5 35	7	5 23	11	5 10	15	4 57	19	4 44	22	4 30	26	4 15	31	4 0	35
34	5 48	4	5 36	7	5 24	11	5 12	14	4 59	18	4 47	22	4 33	26	4 19	30	4 5	34
35	5 49	3	5 37	7	5 25	10	5 14	14	5 2	18	4 49	21	4 37	25	4 23	29	4 9	33
36	5 49	3	5 38	7	5 27	10	5 15	14	5 4	17	4 52	21	4 40	24	4 27	28	4 14	32
37	5 49	3	5 39	7	5 28	10	5 17	13	5 6	17	4 54	20	4 43	24	4 31	27	4 18	31
38	5 50	3	5 39	7	5 29	10	5 19	13	5 8	16	4 57	20	4 46	23	4 34	27	4 22	30
39	5 50	3	5 40	6	5 30	10	5 20	13	5 10	16	4 59	19	4 48	23	4 37	26	4 25	29
40	5 50	3	5 41	6	5 31	9	5 21	12	5 11	16	5 1	19	4 51	22	4 40	25	4 29	29
42	5 51	3	5 42	6	5 33	9	5 24	12	5 15	15	5 5	18	4 56	21	4 46	24	4 35	28
44	5 52	3	5 43	6	5 35	9	5 27	12	5 18	15	5 9	17	5 0	20	4 51	23	4 41	26
46	5 52	3	5 45	6	5 37	8	5 29	11	5 21	14	5 13	17	5 4	20	4 56	23	4 47	25
48	5 53	3	5 46	5	5 38	8	5 31	11	5 23	14	5 16	16	5 8	19	5 0	22	4 52	24
50	5 53	3	5 47	5	5 40	8	5 33	10	5 26	13	5 19	16	5 12	18	5 4	21	4 57	24
52	5 54	3	5 47	5	5 41	8	5 35	10	5 28	13	5 22	15	5 15	18	5 8	20	5 1	23
54	5 54	2	5 48	5	5 42	7	5 37	10	5 31	12	5 24	15	5 18	17	5 12	20	5 5	22
56	5 55	2	5 49	5	5 44	7	5 38	10	5 33	12	5 27	15	5 21	17	5 15	19	5 9	22
58	5 55	2	5 50	5	5 45	7	5 40	9	5 35	12	5 29	14	5 24	17	5 19	19	5 13	21
60	5 55	2	5 51	5	5 46	7	5 41	9	5 37	12	5 32	14	5 27	16	5 22	19	5 17	21
62	5 56	2	5 51	5	5 47	7	5 43	9	5 38	11	5 34	14	5 30	16	5 25	18	5 20	20
64	5 56	2	5 52	4	5 48	7	5 44	9	5 40	11	5 36	13	5 32	16	5 28	18	5 24	20
66	5 56	2	5 53	4	5 49	7	5 46	9	5 42	11	5 38	13	5 35	15	5 31	18	5 27	20
68	5 57	2	5 54	4	5 50	6	5 47	9	5 44	11	5 40	13	5 37	15	5 33	17	5 30	19
70	5 57	2	5 54	4	5 51	6	5 48	9	5 45	11	5 42	13	5 39	15	5 36	17	5 33	19
72	5 57	2	5 55	4	5 52	6	5 50	8	5 47	11	5 44	13	5 41	15	5 39	17	5 36	19
74	5 58	2	5 55	4	5 53	6	5 51	8	5 48	10	5 46	12	5 43	15	5 41	17	5 39	19
76	5 58	2	5 56	4	5 54	6	5 52	8	5 49	10	5 48	12	5 45	14	5 44	16	5 41	18
80	5 58	2	5 57	4	5 45	6	5 53	8	5 51	10	5 50	12	5 48	14	5 46	16	5 44	18
	H.Ang	Alt.	H.Ang	Alt.	H.Ang	Alt.	H.Ang	Alt.	H.Ang	Alt.	H.Ang	Alt.	H.Ang	Alt.	H.Ang	Alt.	H.Ang	Alt.
	2°		4°		6°		8°		10°		12°		14°		16°		18°	

TABLE 40.

HORARY ANGLES and ALTITUDES of the Sun or Star, by which the TIME and AZIMUTH are obtained with the greatest accuracy.

Declination.

Lat	20°		22°		24°		26°		28°		30°		32°		34°	
	H.Ang	Alt.	H.Ang	Alt.	H.Ang	Alt.	H Ang	Alt.	H.Ang	Alt.	H.Ang	Alt.	H-Ang	Alt.	H.Ang	Alt.
°	5 m	°	h m	°	h m	°	h m	°	h m	°	h m	°	h m	°	h m	°
1	5 49	3	5 50	3	5 51	2	5 52	2	5 52	2	5 53	2	5 54	2	5 54	2
2	5 38	6	5 40	5	5 42	5	5 44	5	5 45	4	5 46	4	5 47	4	5 48	4
3	5 27	9	5 30	8	5 33	7	5 35	7	5 37	6	5 39	6	5 41	6	5 42	5
4	5 16	12	5 20	11	5 24	10	5 27	9	5 30	9	5 32	8	5 34	8	5 36	7
5	5 4	15	5 10	13	5 15	12	5 19	11	5 22	11	5 25	10	5 28	9	5 30	9
6	4 53	18	5 0	16	5 5	15	5 10	14	5 14	13	5 18	12	5 21	11	5 24	11
7	4 41	21	4 49	19	4 56	17	5 2	16	5 7	15	5 11	14	5 15	13	5 18	13
8	4 29	24	4 39	22	4 46	20	4 53	19	4 59	17	5 4	16	5 8	15	5 12	14
9	4 17	27	4 28	25	4 37	23	4 44	21	4 51	20	4 56	18	5 1	17	5 6	16
10	4 4	30	4 16	28	4 27	25	4 35	23	4 43	22	4 49	20	4 54	19	4 59	18
11	3 51	34	4 5	31	4 16	28	4 26	26	4 34	24	4 41	22	4 48	21	4 53	20
12	3 37	37	3 53	34	4 6	31	4 17	28	4 26	26	4 34	25	4 40	23	4 47	22
13	3 23	41	3 41	37	3 55	34	4 7	31	4 17	29	4 26	27	4 33	25	4 40	24
14	3 7	45	3 28	40	3 44	37	3 57	33	4 8	31	4 18	29	4 26	27	4 33	26
15	2 50	49	3 14	44	3 32	40	3 47	36	3 59	34	4 9	31	4 18	29	4 26	28
16	2 32	54	2 59	47	3 20	43	3 36	39	3 49	36	4 1	33	4 11	31	4 19	30
17	2 11	59	2 43	51	3 7	46	3 25	42	3 40	39	3 52	36	4 3	34	4 12	32
18	1 47	65	2 26	56	2 53	49	3 13	45	3 29	41	3 43	38	3 55	36	4 5	34
19	1 16	72	2 6	60	2 37	53	3 0	48	3 19	44	3 34	41	3 46	38	3 57	36
20	0 0	90	1 43	66	2 21	57	2 47	51	3 7	47	3 24	43	3 38	40	3 49	38
21	1 14	73	1 13	73	2 2	62	2 32	55	2 55	50	3 13	46	3 28	43	3 41	40
22	1 43	66	0 0	90	1 39	67	2 16	59	2 42	53	3 2	49	3 19	45	3 33	42
23	2 4	61	1 11	73	1 10	74	1 58	63	2 28	57	2 51	51	3 9	48	3 24	44
24	2 21	57	1 39	67	0 0	90	1 36	68	2 13	60	2 38	54	2 58	50	3 15	47
25	2 35	54	2 0	62	1 9	74	1 8	75	1 55	64	2 25	58	2 47	53	3 5	49
26	2 47	51	2 16	59	1 36	68	0 0	90	1 34	69	2 9	61	2 35	56	2 55	52
27	3 0	49	2 30	56	1 56	64	1 7	75	1 6	76	1 52	65	2 21	59	2 44	54
28	3 7	47	2 42	53	2 13	60	1 34	69	0 0	90	1 32	70	2 7	62	2 32	57
29	3 16	45	2 53	51	2 26	57	1 53	65	1 6	76	1 5	76	1 50	66	2 19	60
30	3 24	43	3 2	49	2 38	54	2 9	61	1 32	70	0 0	90	1 30	71	2 5	64
31	3 31	42	3 11	47	2 49	52	2 23	58	1 51	66	1 4	76	1 4	77	1 48	67
32	3 38	40	3 19	45	2 58	50	2 35	56	2 7	62	1 30	71	0 0	90	1 28	71
33	3 44	39	3 26	43	3 7	48	2 45	54	2 20	60	1 49	67	1 3	77	1 3	77
34	3 49	38	3 33	42	3 15	47	2 55	52	2 32	57	2 5	63	1 28	72	0 0	90
35	3 55	37	3 39	41	3 22	45	3 3	50	2 42	55	2 18	61	1 47	68	1 2	77
36	4 0	36	3 45	40	3 29	44	3 11	48	2 52	53	2 30	58	2 3	65	1 27	72
37	4 4	35	3 50	39	3 35	43	3 19	47	3 0	51	2 40	56	2 16	62	1 46	68
38	4 9	34	3 55	38	3 41	41	3 25	45	3 8	50	2 49	54	2 28	59	2 1	65
39	4 13	33	4 0	37	3 47	40	3 32	44	3 16	48	2 58	53	2 38	57	2 14	62
40	4 17	32	4 5	36	3 52	39	3 38	43	3 23	47	3 6	51	2 47	55	2 26	60
42	4 25	31	4 13	34	4 1	37	3 49	41	3 35	45	3 20	48	3 4	52	2 46	57
44	4 31	29	4 21	33	4 10	36	3 59	39	3 46	43	3 33	46	3 19	50	3 4	54
46	4 38	28	4 28	31	4 18	34	4 8	38	3 56	41	3 44	44	3 32	48	3 17	51
48	4 43	27	4 35	30	4 25	33	4 16	36	4 6	39	3 55	42	3 43	46	3 30	49
50	4 49	27	4 41	29	4 32	32	4 23	35	4 14	38	4 4	41	3 54	44	3 42	47
52	4 54	26	4 46	28	4 39	31	4 30	34	4 22	37	4 13	39	4 3	42	3 53	45
54	4 59	25	4 52	28	4 45	30	4 37	33	4 29	36	4 21	38	4 12	41	4 3	43
56	5 3	24	4 57	27	4 50	29	4 43	32	4 36	35	4 28	37	4 20	40	4 12	42
58	5 7	24	5 2	26	4 55	29	4 49	31	4 42	34	4 35	36	4 28	39	4 20	41
60	5 11	23	5 6	26	5 0	28	4 55	30	4 48	33	4 42	35	4 35	38	4 28	40
62	5 15	23	5 10	25	5 5	27	5 0	30	4 54	32	4 48	35	4 42	37	4 36	39
64	5 19	22	5 15	25	5 10	27	5 5	29	5 0	31	4 55	34	4 49	36	4 43	39
66	5 23	22	5 19	24	5 14	26	5 10	29	5 5	31	5 0	33	4 55	35	4 50	38
68	5 26	22	5 22	24	5 19	26	5 15	28	5 10	30	5 6	33	5 2	35	4 57	37
70	5 30	21	5 26	23	5 23	26	5 19	28	5 15	30	5 11	32	5 7	34	5 3	36
	H.Ang	Alt.	H Ang	Alt	H.Ang	Alt.	H.Ang	Alt.	H.Ang	Alt.	H.Ang	Alt.	H.Ang	Alt.	H.Ang	Alt.
	20°		22°		24°		26°		28°		30°		32°		34°	

TABLE 40.

Horary Angles and Altitudes of the Sun or Star, by which the Time and Azimuth are obtained with the greatest accuracy.

Declination.

Lat	36°		38°		40°		42°		44°		46°		48°		50°	
	H.Ang	Alt.	H Ang	Alt.	H.Ang	Alt.	H.Ang	Alt.	H.Ang	Alt.	H·Ang	Alt.	H.Ang	Alt.	H.Ang	Alt.
°	h m	°	h m	°	h m	°	h m	°	h m	°	h m	°	h m	°	h m	°
1	5 54	2	5 55	2	5 55	2	5 56	1	5 56	1	5 56	1	5 56	1	5 57	1
2	5 49	3	5 50	3	5 50	3	5 51	3	5 52	3	5 52	3	5 53	3	5 53	3
3	5 43	5	5 46	5	5 46	5	5 47	4	5 48	4	5 48	4	5 49	4	5 50	4
4	5 38	7	5 39	7	5 41	6	5 42	6	5 43	6	5 45	6	5 46	5	5 47	5
5	5 32	9	5 34	8	5 36	8	5 38	7	5 39	7	5 41	7	5 42	7	5 43	7
6	5 27	10	5 29	10	5 31	9	5 33	9	5 35	9	5 37	8	5 38	8	5 40	8
7	5 21	12	5 24	11	5 26	11	5 29	11	5 31	10	5 33	10	5 35	9	5 36	9
8	5 15	14	5 19	13	5 21	13	5 24	12	5 27	12	5 29	11	5 31	11	5 33	10
9	5 10	15	5 13	15	5 16	14	5 19	14	5 22	13	5 25	13	5 27	12	5 29	12
10	5 4	17	5 8	16	5 11	16	5 15	15	5 18	14	5 21	14	5 23	14	5 26	13
11	4 58	19	5 2	18	5 6	17	5 10	17	5 14	16	5 17	15	5 20	15	5 22	14
12	4 52	21	4 57	20	5 1	19	5 5	18	5 9	17	5 13	17	5 16	16	5 19	16
13	4 46	23	4 51	21	4 56	20	5 1	20	5 5	19	5 8	18	5 12	18	5 15	17
14	4 40	24	4 46	23	4 51	22	4 56	21	5 0	20	5 4	20	5 8	19	5 12	18
15	4 33	26	4 40	25	4 46	24	4 51	23	4 56	22	5 0	21	5 4	20	5 8	20
16	4 27	28	4 34	27	4 40	25	4 46	24	4 51	23	4 56	23	5 0	22	5 4	21
17	4 20	30	4 28	28	4 35	27	4 41	26	4 46	25	4 51	24	4 56	23	5 1	22
18	4 14	32	4 22	30	4 29	29	4 35	28	4 41	26	4 47	25	4 52	25	4 57	24
19	4 7	34	4 15	32	4 23	30	4 30	29	4 36	28	4 42	27	4 48	26	4 53	25
20	4 0	36	4 9	34	4 17	32	4 25	31	4 31	30	4 38	28	4 43	27	4 49	27
21	3 52	38	4 2	36	4 11	34	4 19	32	4 26	31	4 33	30	4 39	29	4 45	28
22	3 45	40	3 55	38	4 5	36	4 13	34	4 21	33	4 28	31	4 35	30	4 41	29
23	3 37	42	3 48	39	3 58	37	4 7	36	4 16	34	4 23	33	4 30	32	4 37	31
24	3 29	44	3 41	41	3 52	39	4 1	38	4 10	36	4 18	34	4 25	33	4 32	32
25	3 20	46	3 33	43	3 45	41	3 55	39	4 5	38	4 13	36	4 21	35	4 28	34
26	3 11	48	3 25	45	3 38	43	3 49	41	3 59	39	4 8	38	4 16	36	4 23	35
27	3 2	51	3 17	48	3 30	45	3 42	43	3 53	41	4 2	39	4 11	38	4 19	36
28	2 52	53	3 8	50	3 23	47	3 35	45	3 46	43	3 56	41	4 6	39	4 14	38
29	2 41	56	2 59	52	3 15	49	3 28	47	3 40	44	3 50	42	4 0	41	4 9	39
30	2 30	58	2 49	54	3 6	51	3 20	49	3 33	46	3 44	44	3 55	42	4 4	41
31	2 17	61	2 39	57	2 57	53	3 13	51	3 26	48	3 38	46	3 49	44	3 59	42
32	2 3	64	2 28	60	2 47	56	3 4	53	3 19	50	3 32	48	3 43	46	3 54	44
33	1 47	68	2 15	62	2 37	58	2 55	55	3 11	52	3 25	49	3 37	47	3 48	45
34	1 27	72	2 1	65	2 26	61	2 46	57	3 3	54	3 17	51	3 30	49	3 42	47
35	1 2	78	1 45	69	2 14	63	2 36	59	2 54	56	3 10	53	3 24	51	3 36	49
36	0 0	90	1 26	73	2 0	66	2 25	62	2 45	58	3 2	55	3 17	52	3 30	50
37	1 2	78	1 1	78	1 44	70	2 13	64	2 35	60	2 53	57	3 9	54	3 23	52
38	1 26	73	0 0	90	1 26	74	1 59	66	2 24	62	2 44	59	3 1	56	3 16	54
39	1 45	69	1 1	78	1 1	78	1 44	70	2 12	65	2 34	61	2 53	58	3 9	55
40	2 0	66	1 26	73	0 0	90	1 25	74	1 59	68	2 23	63	2 44	60	3 1	57
42	2 23	62	1 59	67	1 25	74	0 0	90	1 25	75	1 58	69	2 23	64	2 44	61
44	2 45	58	2 24	62	1 59	68	1 25	74	0 0	90	1 25	75	1 58	69	2 23	65
46	3 3	55	2 44	59	2 23	63	1 58	68	1 25	75	0 0	90	1 25	76	1 59	70
48	3 17	52	3 1	56	2 44	60	2 23	64	1 58	69	1 25	76	0 0	90	1 25	76
50	3 30	50	3 16	54	3 1	57	2 44	61	2 23	65	1 59	70	1 25	76	0 0	90
52	3 42	48	3 30	51	3 16	55	3 1	58	2 44	62	2 24	66	1 59	70	1 26	77
54	3 53	46	3 42	49	3 30	53	3 17	56	3 2	59	2 45	63	2 25	67	2 0	71
56	4 3	45	3 53	48	3 42	51	3 30	54	3 17	57	3 3	60	2 46	64	2 26	68
58	4 12	44	4 3	47	3 54	49	3 43	52	3 32	55	3 19	58	3 4	61	2 47	65
60	4 21	43	4 13	45	4 4	48	3 55	51	3 44	53	3 33	56	3 20	59	3 6	62
62	4 29	42	4 22	44	4 14	47	4 6	49	3 56	52	3 46	54	3 35	57	3 23	60
64	4 37	41	4 30	43	4 23	46	4 16	48	4 8	51	3 59	53	3 49	56	3 38	59
66	4 45	40	4 39	42	4 32	45	4 25	47	4 18	49	4 10	52	4 1	55	3 52	57
68	4 52	39	4 46	42	4 41	44	4 35	46	4 28	48	4 21	51	4 13	53	4 5	56
70	4 59	39	4 54	41	4 49	43	4 43	45	4 38	48	4 31	50	4 22	52	4 17	55
	H Ang	Alt.	H Ang	Alt.	H.Ang	Alt.	H.Ang	Alt.	H.Ang	Alt.	H.Ang	Alt.	H.Ang	Alt	H Ang	Alt.
	36°		38°		40°		42°		44°		46°		48°		50°	

TABLE 41.

AMPLITUDES.

DECLINATION.

Lat.	1°		2°		3°		4°		5°		6°		7°		8°		9°		10°		11°		12°		13°		14°	
°	°	'		'	°	'	°	'	°	'	°	'	°	'	°	'	°	'	°	'	°	'	°	'	°	'	°	'
1	1	0	2	0	3	0	4	0	5	0	6	0	7	1	8	0	9	0	10	0	11	0	12	0	13	0	14	0
3	1	0	2	0	3	0	4	0	5	0	6	0	7	0	8	1	9	1	10	1	11	1	12	1	13	1	14	1
5	1	0	2	0	3	1	4	1	5	1	6	1	7	2	8	2	9	2	10	2	11	3	12	3	13	3	14	3
7	1	0	2	1	3	1	4	2	5	2	6	3	7	3	8	4	9	4	10	5	11	5	12	5	13	6	14	6
9	1	1	2	1	3	2	4	3	5	4	6	5	7	5	8	6	9	7	10	8	11	8	12	9	13	10	14	11
10	1	1	2	2	3	3	4	4	5	5	6	6	7	6	8	8	9	9	10	10	11	11	12	11	13	12	14	13
11	1	1	2	2	3	3	4	4	5	6	6	7	7	7	8	9	9	10	10	11	11	13	12	13	13	15	14	16
12	1	1	2	3	3	4	4	5	5	7	6	8	7	9	8	11	9	12	10	13	11	15	12	16	13	18	14	19
13	1	2	2	3	3	5	4	6	5	8	6	10	7	11	8	13	9	14	10	16	11	18	12	19	13	21	14	23
14	1	2	2	4	3	6	4	7	5	9	6	11	7	13	8	15	9	17	10	19	11	20	12	22	13	24	14	26
15	1	2	2	4	3	6	4	8	5	11	6	13	7	15	8	17	9	19	10	21	11	24	12	26	13	28	14	30
16	1	2	2	5	3	7	4	10	5	12	6	15	7	17	8	19	9	22	10	24	11	27	12	29	13	32	14	35
17	1	3	2	5	3	8	4	11	5	14	6	17	7	19	8	22	9	25	10	28	11	31	12	33	13	36	14	39
18	1	3	2	6	3	9	4	12	5	15	6	19	7	22	8	25	9	28	10	31	11	34	12	38	13	41	14	44
19	1	3	2	7	3	10	4	14	5	17	6	21	7	24	8	28	9	31	10	35	11	39	12	42	13	46	14	49
20	1	4	2	8	3	12	4	15	5	19	6	23	7	27	8	31	9	36	10	39	11	43	12	47	13	51	14	55
21	1	4	2	9	3	13	4	17	5	21	6	26	7	30	8	34	9	39	10	43	11	48	12	52	13	57	15	1
22	1	5	2	9	3	14	4	19	5	24	6	28	7	33	8	38	9	43	10	48	11	53	12	57	14	2	15	7
23	1	5	2	10	3	16	4	21	5	26	6	31	7	36	8	42	9	47	10	52	11	58	13	3	14	9	15	14
24	1	6	2	11	3	17	4	23	5	28	6	34	7	40	8	46	9	52	10	57	12	3	13	9	14	15	15	21
25	1	6	2	12	3	19	4	25	5	31	6	37	7	44	8	50	9	56	11	3	12	9	13	16	14	22	15	29
26	1	7	2	14	3	20	4	27	5	34	6	41	7	48	8	54	10	1	11	8	12	15	13	22	14	30	15	37
27	1	7	2	15	3	22	4	29	5	37	6	44	7	52	8	59	10	7	11	14	12	22	13	30	14	37	15	45
28	1	8	2	16	3	24	4	32	5	40	6	48	7	56	9	4	10	12	11	21	12	29	13	37	14	46	15	54
29	1	9	2	17	3	26	4	34	5	43	6	52	8	1	9	9	10	18	11	27	12	36	13	45	14	54	16	3
30	1	9	2	19	3	28	4	37	5	47	6	56	8	5	9	15	10	24	11	34	12	44	13	53	15	3	16	13
31	1	10	2	20	3	30	4	40	5	50	7	0	8	10	9	21	10	31	11	41	12	52	14	2	15	13	16	24
32	1	11	2	22	3	32	4	43	5	54	7	5	8	16	9	27	10	38	11	49	13	0	14	11	15	23	16	34
33	1	12	2	23	3	35	4	46	5	58	7	10	8	21	9	33	10	45	11	57	13	9	14	21	15	34	16	46
34	1	12	2	25	3	37	4	50	6	2	7	15	8	27	9	40	10	53	12	5	13	18	14	31	15	45	16	58
35	1	13	2	27	3	40	4	53	6	6	7	20	8	33	9	47	11	1	12	14	13	28	14	42	15	56	17	11
36	1	14	2	28	3	43	4	57	6	11	7	25	8	40	9	54	11	9	12	24	13	39	14	54	16	9	17	24
37	1	15	2	30	3	45	5	1	6	16	7	31	8	47	10	2	11	18	12	33	13	49	15	5	16	22	17	38
38	1	16	2	32	3	48	5	5	6	21	7	37	8	54	10	10	11	27	12	44	14	1	15	18	16	35	17	53
39	1	17	2	34	3	52	5	9	6	26	7	44	9	1	10	19	11	37	12	55	14	13	15	31	16	50	18	8
40	1	18	2	37	3	55	5	13	6	32	7	51	9	9	10	28	11	47	13	6	14	25	15	45	17	5	18	25
41	1	20	2	39	3	59	5	18	6	38	7	58	9	18	10	38	11	58	13	18	14	39	15	59	17	20	18	42
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66	2	28	4	55	7	24	9	53	12	22	14	54	17	26	20	1	22	37	25	16	27	59	30	45	33	35	36	30
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TABLE 42.

Correction in finding the Time of High Water.

Moon's passage over Meridian.	Moon's Semidiameter.									Moon's passage over Meridian.
	14′30″	14′45″	15′ 0″	15′15″	15′30″	15′45″	16′ 0″	16′15″	16′30″	
h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
0 0	—0 4	—0 3	—0 2	—0 1	—0 0	+0 1	+0 2	+0 3	+0 5	12 0
0 20	—0 8	—0 8	—0 7	—0 6	—0 5	—0 4	—0 3	—0 2	—0 1	12 20
0 40	—0 12	—0 12	—0 11	—0 11	—0 10	—0 10	—0 9	—0 9	—0 8	12 40
1 0	—0 17	—0 17	—0 17	—0 16	—0 16	—0 16	—0 15	—0 15	—0 15	13 0
1 20	—0 22	—0 22	—0 22	—0 22	—0 22	—0 22	—0 22	—0 22	—0 22	13 20
1 40	—0 27	—0 27	—0 27	—0 28	—0 28	—0 28	—0 29	—0 29	—0 29	13 40
2 0	—0 31	—0 31	—0 32	—0 32	—0 33	—0 33	—0 34	—0 35	—0 36	14 0
2 20	—0 36	—0 36	—0 37	—0 38	—0 39	—0 40	—0 41	—0 42	—0 43	14 20
2 40	—0 40	—0 41	—0 42	—0 43	—0 44	—0 45	—0 46	—0 47	—0 49	14 40
3 0	—0 44	—0 45	—0 47	—0 48	—0 49	—0 51	—0 52	—0 54	—0 56	15 0
3 30	—0 49	—0 51	—0 53	—0 55	—0 56	—0 58	—1 0	—1 2	—1 4	15 30
4 0	—0 55	—0 57	—0 59	—1 0	—1 2	—1 5	—1 7	—1 10	—1 12	16 0
4 30	—0 58	—1 0	—1 2	—1 3	—1 5	—1 7	—1 10	—1 13	—1 16	16 30
5 0	—1 0	—1 2	—1 4	—1 6	—1 8	—1 10	—1 13	—1 16	—1 19	17 0
5 30	—0 59	—1 1	—1 3	—1 5	—1 7	—1 9	—1 12	—1 15	—1 18	17 30
6 0	—0 55	—0 56	—0 58	—1 0	—1 2	—1 4	—1 6	—1 9	—1 12	18 0
6 20	—0 49	—0 50	—0 51	—0 52	—0 54	—0 56	—0 58	—1 0	—1 3	18 20
6 40	—0 43	—0 44	—0 45	—0 46	—0 47	—0 48	—0 49	—0 51	—0 53	18 40
6 50	—0 37	—0 37	—0 38	—0 39	—0 40	—0 41	—0 42	—0 43	—0 45	18 50
7 0	—0 32	—0 32	—0 33	—0 33	—0 34	—0 34	—0 35	—0 36	—0 37	19 0
7 10	—0 27	—0 27	—0 27	—0 27	—0 28	—0 28	—0 28	—0 29	—0 29	19 10
7 20	—0 22	—0 22	—0 22	—0 22	—0 22	—0 22	—0 22	—0 22	—0 22	19 20
7 30	—0 16	—0 16	—0 16	—0 15	—0 15	—0 15	—0 14	—0 14	—0 14	19 30
7 40	—0 11	—0 11	—0 10	—0 10	—0 9	—0 9	—0 8	—0 7	—0 6	19 40
7 50	—0 6	—0 6	—0 5	—0 4	—0 3	—0 2	—0 1	—0 0	+0 2	19 50
8 0	—0 1	—0 0	+0 1	+0 2	+0 3	+0 4	+0 6	+0 7	+0 9	20 0
8 20	+0 5	+0 6	+0 7	+0 9	+0 11	+0 13	+0 15	+0 17	+0 19	20 20
8 40	+0 11	+0 12	+0 14	+0 16	+0 18	+0 20	+0 22	+0 25	+0 28	20 40
9 0	+0 14	+0 16	+0 18	+0 20	+0 22	+0 24	+0 26	+0 29	+0 32	21 0
9 30	+0 16	+0 18	+0 20	+0 22	+0 24	+0 27	+0 30	+0 33	+0 36	21 30
10 0	+0 15	+0 17	+0 19	+0 21	+0 23	+0 25	+0 27	+0 30	+0 34	22 0
10 30	+0 12	+0 14	+0 15	+0 17	+0 19	+0 21	+0 23	+0 26	+0 30	22 30
11 0	+0 7	+0 8	+0 10	+0 12	+0 14	+0 16	+0 18	+0 20	+0 23	23 0
11 20	+0 4	+0 5	+0 6	+0 7	+0 9	+0 11	+0 13	+0 15	+0 17	23 20
11 40	+0 0	+0 1	+0 2	+0 3	+0 5	+0 7	+0 8	+0 10	+0 12	23 40
12 0	—0 4	—0 3	—0 2	—0 1	—0 0	+0 1	+0 2	+0 3	+0 5	24 0
	14′30″	14′45″	15′ 0″	15′15″	15′30″	15′45″	16′ 0″	16′15″	16′30″	

TABLE 43.

For converting Intervals of Mean Solar Time into Equivalent Intervals of Sidereal Time.—From the Nautical Almanac.

HOURS.

Hours of Mean Time.	Equivalents in Sidereal Time. h	m	s
1	1	0	[illegible]
2	2	0	[illegible]
3	3	0	[illegible]
4	4	0	[illegible]
5	5	0	[illegible]
6	6	0	[illegible]
7	7	1	[illegible]
8	8	1	[illegible]
9	9	1	[illegible]
10	10	1	[illegible]
11	11	1	[illegible]
12	12	1	[illegible]
13	13	2	[illegible]
14	14	2	[illegible]
15	15	2	[illegible]
16	16	2	[illegible]
17	17	2	[illegible]
18	18	2	[illegible]
19	19	3	[illegible]
20	20	3	[illegible]
21	21	3	[illegible]
22	22	3	[illegible]
23	23	3	[illegible]
24	24	3	[illegible]

MINUTES.

Minutes of Mean Time.	Equivalents in Sidereal Time. m	s	Minutes of Mean Time.	Equivalents in Sidereal Time. m	s
1	1	[illegible]	31	31	[illegible]
2	2	[illegible]	32	32	[illegible]
3	3	[illegible]	33	33	[illegible]
4	4	[illegible]	34	34	[illegible]
5	5	[illegible]	35	35	[illegible]
6	6	[illegible]	36	36	[illegible]
7	7	[illegible]	37	37	[illegible]
8	8	[illegible]	38	38	[illegible]
9	9	[illegible]	39	39	[illegible]
10	10	[illegible]	40	40	[illegible]
11	11	[illegible]	41	41	[illegible]
12	12	[illegible]	42	42	[illegible]
13	13	[illegible]	43	43	[illegible]
14	14	[illegible]	44	44	[illegible]
15	15	[illegible]	45	45	[illegible]
16	16	[illegible]	46	46	[illegible]
17	17	[illegible]	47	47	[illegible]
18	18	[illegible]	48	48	[illegible]
19	19	[illegible]	49	49	[illegible]
20	20	[illegible]	50	50	[illegible]
21	21	[illegible]	51	51	[illegible]
22	22	[illegible]	52	52	[illegible]
23	23	[illegible]	53	53	[illegible]
24	24	[illegible]	54	54	[illegible]
25	25	[illegible]	55	55	[illegible]
26	26	[illegible]	56	56	[illegible]
27	27	[illegible]	57	57	[illegible]
28	28	[illegible]	58	58	[illegible]
29	29	[illegible]	59	59	[illegible]
30	30	[illegible]	60	60	[illegible]

SECONDS.

Seconds of Mean Time.	Equivalents in Sidereal Time. s	Seconds of Mean Time.	Equivalents in Sidereal Time. s
1	[illegible]	31	[illegible]
2	[illegible]	32	[illegible]
3	[illegible]	33	[illegible]
4	[illegible]	34	[illegible]
5	[illegible]	35	[illegible]
6	[illegible]	36	[illegible]
7	[illegible]	37	[illegible]
8	[illegible]	38	[illegible]
9	[illegible]	39	[illegible]
10	[illegible]	40	[illegible]
11	[illegible]	41	[illegible]
12	[illegible]	42	[illegible]
13	[illegible]	43	43·1177
14	[illegible]	44	44·1205
15	[illegible]	45	45·1232
16	[illegible]	46	46·1259
17	[illegible]	47	47·1287
18	[illegible]	48	48·1314
19	[illegible]	49	49·1342
20	[illegible]	50	50·1369
21	[illegible]	51	51·1396
22	[illegible]	52	52·1424
23	[illegible]	53	53·1451
24	[illegible]	54	54·1479
25	[illegible]	55	55·1506
26	[illegible]	56	56·1533
27	[illegible]	57	57·1561
28	[illegible]	58	58·1588
29	[illegible]	59	59·1615
30	[illegible]	60	60·1643

TABLE 43a.

The Mean Reduction of the Moon's Horizontal Parallax, for the spheroidal figure of the Earth.

Latitude [illegible] [illegible] [illegible] 30° 34° 38° 43° 47° 51° 56° 60° 66° 71° 79° 90°

Reduction 1" 2" 2½" 3" 4" 4½" 5" 6" 7" 8" 9" 10" 10½" 11"

TABLE 44.

LATITUDES AND LONGITUDES,

Of the principal Ports, Harbours, Capes, &c. in the World, from the latest Observations, Surveys, &c. &c.;
With Descriptions and Heights of the Principal Light-houses above high water,* the Times of High Water, and the Rise of the Tide.

* Where there are Two Lights, the height of the highest only is given.

Explanations.

l.	light	*r.*	revolving	*l. s.*	light ship
f.	fixed	*i.*	intermitting or flashing	*fl. st.*	flag staff.

From the Meridian of Greenwich.

Places.	Lat.	Long.	times	rise
	° ′	° ′	h m	ft.
ENGLAND,				
South Coast,				
LONDON, St.Paul ...	51 31 N	0 6 W	2 7	19
Greenwich Observatory.	51 29	0 0		
Chatham Dock Yard...	51 24	0 35 E		
Sheerness Flag Staff....	51 27	0 45	12 0	15
N.Foreland, *l.f.* 340ft..	51 22	1 27	11 45	16
Deal castle...........	51 13	1 24	11 25	19
S.Foreland, 2 *l.f.* 372ft.	51 8	1 22	11 6	15
Dover castle.	51 8	1 19	11 16	20
Dungeness, *l.f.* 92ft ...	50 55	0 58	10 50	24
Hastings	50 52	0 38	10 36	
Beachy hd, *l.r.*2m 285 ft	50 44	0 13	10 15	20
Brighton	50 50	0 9 W	10 6	16
Shoreham	50 50	0 16	11 21	16
Arundel..............	50 51	0 36	11 20	16
Owers, *l.s.* 26ft.......	50 41	0 39	11 0	15
Chichester church spire.	50 50	0 47		
Portsmouth church....	50 47	1 6	11 40	18
Southampton spire	50 54	1 24		
Isle of Wight.				
Cowes................	50 46	1 16	11 0	15
Bembridge, *l.f.* 32ft....	50 42	1 2	11 40	
Dunnose	50 37	1 12	9 56	
St.Catherine'spt.*lf.*178ft	50 36	1 18	8 30	
Needles, *l.f.* 469 ft. ...	50 40	1 34	9 45	9
S. Coast of England				
Hurst, 2 *l.f.* 66 ft.	50 42	1 38	10 0	
Poole................	50 43	1 59	9 0	7
St.Alban's head.......	50 34	2 3	7 30	
Weymouth....... ...	50 36	2 27	6 30	7
Portland, 2 *l.f.* 198ft ..	50 31	2 27		
Bridport.............	50 41	2 52		
Exmouth bar.	50 37	3 22	6 25	14
Berry head, Torbay....	50 24	3 28	6 0	20
Dartmouth dock yard ..	50 21	3 33	6 5	14
Start point,*l.i.*1m 204 ft	50 13	3 38	5 55	20
Praule point..........	50 13	3 43	5 55	
Bolt head...	50 13	3 48	5 55	20
Eddystone, *l.f.* 72 ft. ..	50 11	4 16	5 15	18
Ramehead	50 19	4 13	5 45	
Plymouth dock	50 22	4 10	5 30	18
Looe island..........	50 25	4 27		
Fowey	50 20	4 38	5 30	16
Deadman's pt, *l f* 39ft.	50 13	4 48	5 30	
Falmouth, *l.r.* 20s.65 ft.	50 9	5 3	5 30	18
Black head...........	50 0	5 6		
Lizard point,2 *lf.*223 ft.	49 58	5 12	4 55	18
St.Michael's mount....	50 7	5 29		
Penzance	50 8	5 8	4 30	19
Runnelstone beacon ...	50 2 N	5 39 W		
Land's End..........	50 4	5 42	4 30	
Wolf rock	49 57	5 48		
Longships, *l f.* 88 ft ...	50 4	5 45		
West Coast				
Scilly islands				
St.Agnes,*lr.*1m.138ft	49 54	6 21	4 40	18
St.Mary's..........	49 55	6 17	4 40	18
Seven Stones, *l f,* 38 ft .	50 2	6 7		
Cape Cornwall........	50 8	5 41	4 25	22
St. Ives..............	50 13	5 28	4 30	22
St.Agnes, beacon, 621ft.	50 18	5 13		
Trevose head	50 33	5 2		
Padstow.............	50 35	4 55	5 0	24
Tintagel head.........	50 40	4 45		
Hartland point	51 1	4 31	6 0	
Mort point	51 11	4 13		
Lundyisle,2*l.i.*45s*f*542ft	51 10	4 40	5 30	30
Flatholm, *l f.* 156 ft....	51 23	3 7	6 28	36
Bristol	51 27	2 36	7 16	42
Nash point, 2 *l f.* 167 ft.	51 24	3 33		
Mumbles point,*lf.*114ft	51 34	3 58		
Worms head	51 34	4 19		
Caldy island, *l f.* 210 ft.	51 38	4 41	6 0	34
St.Gowan's point......	51 36	4 56	5 30	36
St.Ann's, 2 *lf.* 192ft ...	51 41	5 10		
Small's, *l f.* 70ft......	51 43	5 40	5 50	
St.David's head	51 55	5 18	6 0	
Strumble head........	52 2	5 4		
Dinas point	52 2	4 53		
Aberystwith, 2 *lts f.* ..	52 25	3 58	7 30	13
Barmouth	52 41	3 55	8 0	13
Bardsey isle,*l f*-129ft...	52 45	4 47	6 15	
Southstack rk,*lr.*2m201f	53 18	4 41		
Brachy Pool head	52 46	4 37		
Holyhead, *l f.* 44 ft....	53 19	4 36		
Skerries, *l.f.* 117ft. ...	53 25	4 36	9 45	
Pt. Lynus,*l.r.*10s.128ft.	53 25	4 17		
Great Ormes head.....	53 20	3 55	10 30	
Air point, 2*lts f.* 49ft ..	53 22	3 19		
Liverpool, *l.s.*.........	53 28	3 17	11 20	27
Walney island *lr* 5m.70ft	54 4	3 12		
Formby point.........	53 33	3 5	10 25	26
Lancaster............	54 3	2 48	11 15	
Selker rock	54 17	3 57		
St.Bees head, *l;f* 333ft .	54 31	3 39	11 0	
Whitehaven,2*lr*,2m*f*47ft	54 33	3 38		
Workington, 2 *l f.* 55ft.	54 40	3 36		
Mary port, 2 *l;f.* 39ft ..	54 44	3 33		

LATITUDES AND LONGITUDES.

Places.	Lat.	Long.	times	rise
	° ′	° ′	h m	ft.
Carlisle	54 54 N	2 55 W	12 0	
Isle of Man,				
Pt. of Ayr, *l.r.* 2m. 106ft	54 28	4 23	10 30	
Douglass, *l.f.* 101ft.	54 9	4 29	10 30	21
Castletown, *l.f.* 22ft.	54 5	4 40		
Calf of Man, 2*l.r.* 2m. 396f	54 3	4 49	10 30	
SCOTLAND,				
West and North Coast,				
Mull of Galloway, *l.i.* 3m 325 feet	54 38	4 52		
Ross head	54 47	4 7		
Burrow head	54 42	4 25		
Scar island	54 39	4 41	11 15	
Port Patrick, *l.f.* 25ft.	54 50	5 8		
Corsewall pt. *l r.* 2m. 112f	55 1	5 10		
Ayr, *l.f.* 35ft.	55 27	4 37		
Irwin	55 37	5 9		
Ailsa craig rock, 1100ft.	55 15	5 7		
Cumbrae isle, *l.f.* 106ft.	55 43	4 55	11 0	
Greenock, *l.f.*	55 57	4 45	11 30	
Glasgow, *l.f.*	55 57	4 41	11 30	
Pladda, 2*l.f.* 130ft.	55 25	5 7	9 0	5
Mull of Kintyre, *l.f.* 297ft	55 19	5 49		
Torivore head	55 54	6 24		
Rhins of Ilay, *l.i.* 150ft.	55 41	6 33		
Ben Nevis, 4368 ft.	56 48	5 0		
Bara head, *l.i.* 3m. 680ft	56 48	7 38		
Skerryvore rock	56 20	7 7		
Dusker rock	56 34	6 57		
Coll island, North end	56 42	6 20		
Rum island, South end	56 55	6 13		
Helsker island	56 56	6 36		
Canna island	57 3	6 27		
Duvegan head	57 30	6 42		
Rea head	57 56	5 32		
More head	58 5	2 18		
Stower head	58 14	5 14		
Cape Wrath, *lr.* 2m. 400ft	58 37	5 0	8 15	
Rona island	58 55	5 52		
Barra island	58 54	6 3		
Farout head	58 37	4 45		
Dunnet head, *l.f.* 346ft.	58 40	3 22		
Duncansby head	58 39	3 0	10 0	
Hebrides,				
Mingala island	56 48	7 33		
South Ulst, south end	57 5	7 12		
Renish head	57 41	6 56		
Glass island, *l.f.* 130ft	57 52	6 33		
Aird point	58 15	6 5		
Butt of Lewis	58 32	6 22	6 45	
Toe head	57 51	7 5		
Gallen head	58 11	7 1		
Flannen isles	58 14	7 30		
St. Kilda point	57 49	8 32		
Hyskar island	57 38	7 39		
Rockal point	57 36	13 39		
Orkney				
Pentland Skerries, 2 *l.f.* 170ft.	58 43	2 55		
Stroma isle, south end	58 43	3 14		
S. Ronaldsha, southpoint	58 45	3 5		

Places.	Lat.	Long.	times	rise
	° ′	° ′	h m	ft.
Copinsha	58 56N	2 48W		
Stronsa, I. south point	59 5	2 41		
Start, *l.r.* 1m. 100ft.	59 18	2 24		
N. Ronaldsha, north pt.	59 23	2 34		
Papa Westra isle, Moud head	59 22	3 3		
Westra island, Noup head	59 19	3 13		
Pomona island,				
Marwick head	59 7	3 27	9 0	
Stromness	58 57	3 26	10 30	
Sule Skerries	59 5	4 14		
Fair island sum.	59 29	1 38	10 0	
Shetland,				
Sumburgh hd, *l.f.* 300ft.	59 51	1 16		
Hangcliff	60 9	0 57	9 30	
Lerwick	60 9	1 9	9 45	10
Rumble island	60 21	0 53		
Outer Skerries	60 30	0 46		
Lambaness	60 48	0 59	9 30	5
Ossa Skerries	60 33	1 36		
Foul Island	60 5	2 4	9 30	
Faro				
Monk rock	61 22	6 42		
Fugloe island	62 21	6 18	3 0	
Mygenes island	62 8	7 39		
East Coast; Scotland,				
Noss head	58 30	3 9		
Clyth ness	58 20	3 16		
Ord head	58 10	3 35		
Tarbetness, *l.i.* 3m. 175ft	57 51	3 48		
Cromartie	57 42	4 1	11 45	14
Inverness	57 31	4 12		
Fort George	57 35	4 5	12 0	
Burgh head	57 43	3 30		
Cullen	57 42	2 50		
Banff	57 40	2 32	11 30	
Kinnaird's hd. *l.f.* 120ft.	57 42	2 1	12 0	
Ratriehead	57 38	1 50		
Peterhead	57 32	1 47	12 45	
Buchanness, *l.i.* 5s. 130ft	57 28	1 46		
Newburgh	57 19	1 57	12 0	
Aberdeen obs.	57 9	2 6	1 45	
Girdleness	57 8	2 6	1 0	
Stonehaven	56 68	2 13	12 30	
Montrose, 2 *l.f* 45ft.	56 42	2 27		
Arbroath	56 34	3 35		
Buddonness, 2 *l.f.* 85 ft.	56 28	2 45	2 0	
Dundee, 2 *l.f.*	56 28	2 68	2 15	
Bell rock, *l.r.* 2m. 100ft.	56 26	2 23		
St. Andrew's	56 21	2 47		
Fifeness	56 17	2 35	4 30	
Ellyness	56 12	2 50		
Edinburgh obs.	56 57	3 11	2 30	
Inchkeith, *l.r.* 1m. 220ft	56 2	3 8		
Fidra	56 6	2 46		
North Berwick	56 4	2 42	1 30	
May island, *l.f.* 240 ft.	56 11	2 33		
The Bass	56 5	2 38		
Dunbar	56 0	2 30	2 0	
St. Abb's head	55 55	2 8		
Eyemouth	55 53	2 6	2 15	

TABLE 44.

LATITUDES AND LONGITUDES.

Places.	Lat.		Long.		times		rise
	°	′	°	′	h	m	ft.
ENGLAND,							
East Coast,							
Berwick, 2 *l f.* 44ft.	55	46N	1	58W	2	18	16
Holy island	55	40	1	47	2	30	
Bamburgh castle	55	37	1	42			
Staples light	55	38	1	37	2	30	
Farn isle, 2*l.i.*½m.*f* 28ft.	55	37	1	38			
Sunderland point	55	35	1	38	3	0	12
Cheviot hill, 2670ft.	55	29	2	8			
Coquet island, *l.f.* 80ft.	55	20	1	32	2	45	15
Tynemouth, *l r.*1m154ft	55	1	1	25	3	3	13
Sunderland, 2*l f.* 73ft.	54	55	1	21	3	3	
Hartlepool, 2 *l.f.*	54	41	1	11	3	30	16
Stockton	54	33	1	20	4	30	
Whitby, *l.f.* 83ft.	54	30	0	37	3	45	13
Scarborough, *l.f.* 56ft.	54	17	0	23	4	25	13
Flamborough hd, *l.r.* 2m							
214 ft.	54	7	0	5	4	30	
Spurn. 2 *l.f.* 100 ft.	53	34	0	7E	5	30	
Lynn Regis	52	47	0	25	6	30	13
Outer Dowsing	53	30	0	55	6	45	13
Haddock's bank	53	33	1	24			
Dudgeon, *l.f.* 38ft.	53	15	0	58	7	30	
Inner Dowsing	53	18	0	34	6	45	16
Leman and Ower. 2*l. r.*							
1m. *f*	53	9	2	3			
Smith's knowl	52	52	2	17	12	0	
Cromer, *l.r.*2m. 274ft.	52	55	1	20			
Foulness	52	56	1	21	9	0	16
Hasborough, 2*l.f.* 137ft.	52	49	1	31	8	0	
Winterton, *l.f.* 52ft.	52	43	1	41	8	15	10
Yarmouth	52	37	1	44	8	40	8
Lowestoft, 2*l.f.* 119ft.	52	29	1	46	9	0	
Southweld	52	20	1	40	10	0	
Aldbro' Knaps	52	8	1	42	10	45	10
Orfordness, 2*l.f.* 83ft.	52	5	1	34	10	40	11
IRELAND,							
West Coast,							
Cape Clear, *l.r.*2m. 455ft	51	26	9	29W	4	0	11
Fastnet rock	51	22	9	36			
Crookhaven	51	30	9	40	3	30	
Mizzen head	51	27	9	50	3	0	
Bantry bay							
Sheep's head	51	34	9	51	3	45	11
Greelagh rocks	51	32	10	6			
Dursey I. west end	51	37	10	10	3	30	
Bull rock	51	38	10	16			
Cow rock	51	28	10	15			
Kenmare harbour					3	30	11
Cod's head	51	43	10	4			
Lamb's head	51	50	10	5			
Hog islands	51	49	10	10			
Bolus head	51	52	10	15			
Skellig's rk, 2*l.f.* 372ft.	51	46	10	32	3	0	
Loop head, *l.f.* 269ft.	52	34	9	56			
Dingle bay,					3	30	
Bray head	51	55	10	21			
Dunmore	52	7	10	22			
Foze rock	52	1	10	40			
Ferriter's island	52	9	10	31	3	30	
Gt, Blaskett, west end	52	11	10	29	3	50	
Ennis, Tuskar	52	14N	10	20W			
Dunorling	52	18	10	20			
Brandon hill, 3126 ft.	52	14	10	16			
Kerry head	52	25	9	51			
Limerick	52	40	8	40	6	0	16
Aranmore, *l.r.*3m. 460ft.	53	7	9	42			
Clare	52	51	8	53			
Hag's head	53	0	9	20			
Galway bay					4	30	
Blackhead	53	11	9	7			
Galway	53	17	9	1			
Arran I. *l r.* 3m. 498ft.	53	8	9	42			
Slyne head, 2*l r.* 2m*f.* 104f	53	24	10	16	5	15	
Shark island	53	38	10	15			
Ennis Turk island	53	45	10	5			
Clare island, *l.f.* 487ft.	53	50	9	58			
Achill head, sum. 2222ft.	53	59	10	12	6	0	
Black rock	54	4	10	22			
North Coast,							
Erris head, 2 *l.f.* 220ft.	54	16	10	1			
Downpatrick head	54	21	9	20			
Killala	54	16	9	17			
Sligo, *l.f.* 74ft.	54	18	8	33	6	45	
Ennis Murry island	54	31	8	54			
Donnegal	54	38	8	7	5	5	
Tillen head, sum. 1415ft	54	41	8	46			
Douras head	54	53	8	40			
Arran, I. north end	55	2	8	33			
Fannet point, *l.f.* 90ft	55	16	7	38			
Tory I. N.W. pt. *l.f.* 125ft	55	16	8	15	6	0	
Horn head	55	15	8	0			
Melmore head	55	17	7	47			
Dunaff head	55	19	7	33			
Malin head	55	22	7	22			
Ennistrahul, *l.r.*2m. 197f	55	27	7	14			
Innishowan hd. *l.f.* 67ft.	55	14	6	55			
Londonderry	55	59	7	12	6	0	
Rachlin, I. west end	55	19	6	13	9	0	
Fair head	55	15	6	3	9	0	
Tor head	55	13	5	58			
Maiden rks. 2*l.f.* 94ft.	55	56	5	45			
East Coast,							
Black head	54	46	5	39			
Carrickfergus	54	43	5	45	10	30	8
Belfast	54	35	5	57	10	5	
Copeland, I. *l.f.* 131ft.	54	42	5	32			
South rock, *l.r.*1½m. 52ft	54	24	5	25			
Dundrum	54	13	5	48			
Dundalk	54	0	6	24	10	45	
Clougher head	54	50	6	12			
Drogheda bar, 3 *l.f.*	53	44	6	13	10	45	
Howth head, *l.f.* 43ft.	53	24	6	4			
Howth baily, *l.f.* 114ft.	53	22	6	3			
Dublin observatory	53	23	6	21	10	30	12
Wicklow, 2 *l.f.* 250ft.	52	59	6	0	9	0	
Arklow, *l.s.* 25ft.	52	44	5	57	9	15	
Glascarrick	52	37	6	10			
Wexford harbour	52	22	6	19	7	30	

LATITUDES AND LONGITUDES.

Places.	Lat.	Long.	times	rise
	° ′	° ′	h m	ft.
South Coast,				
Carnsore poin!	52 11N	6 18W		
Tusker rk.*l.r.*2m. 101ft.	52 12	6 12	6 30	
Saltees rocks, *l.f.*25ft...	52 3	6 38	5 40	12
Hook, *l.f.* 139ft	52 7	6 56		
Waterford	52 13	7 9		
Tramore..............	52 7	7 10		
Dungarvon	52 4	7 37	4 30	
Ram head............	51 55	7 41		
Youghal.............	51 54	7 49	5 0	11
Dog's nose...........	51 48	8 16		
Cork, Roche point, *l.f.* 92 ft.	51 54	8 29	4 30	18
Kinsale, Old Head, *l.f.* 274 ft..	51 37	8 32	4 30	
Seven heads..........	51 33	8 42		
Dundedy head........	51 33	8 54	4 0	11
Ross................	51 35	8 58		
Stags off Toe head	51 27	9 10		
Baltimore............	51 27	9 20	3 45	12
NORWAY,				
Hægholmen, *l.f.* 24ft. .	59 53	10 45E		
Christiana fiord				
Steilene, I. *l.f.* 23ft.	59 49	10 38		
Filtvets, *l.f.* 25ft......	59 34	10 41		
Rödlangnæbben, *l.f.*36ft	59 31	10 29		
Bastöe, *l.f.* 29ft.	59 23	10 36		
Tülehük, I.*l.r.*½m.43ft.	59 10	10 40		
Tœrder, *l.f.* 216ft.	59 4	10 36		
Langöe I. *l.f.* 41ft. ...	58 59	9 51		
Jomfruland,*l.r.*½m.134ft	58 51	9 41		
Christiansand.........	58 8	8 3		
Lindesnæs, the Naze, *l.f.* 146 ft.............	57 58	7 3	11 15	
Marköe, *l.f.* 201ft.....	57 59	6 59		
Listerland, *l.r.*1m. 129ft	58 6	6 32		
Varnes pt. *l.f.* 90ft. ...	58 10	6 36		
Hvidingsöe,I. *l.f.* 133ft.	59 4	5 21		
Temginæs, *l.f.* 25ft....	59 2	5 33		
Skudesnas, *l.f.* 77ft. ..	59 9	5 15		
Hoïevarde, *l.f.* 65ft....	59 20	5 17		
Bergen,				
Nordnæs, *l.f.* 41ft ..	60 24	5 15	1 30	
Rondöe, I. *l.f.* 168ft. .	62 25	5 35		
Walderhong, *l.f* 41ft. .	62 30	6 7		
Gvitholmen,orWintholm island, *l.r.*1m. 131 ft.	63 2	7 13		
Christiansund,				
Staonæsset, *l.f.* 65 ft.	63 8	7 33		
Edd island,				
Ringholman, *l.f.* 36ft.	63 19	8 13		
Drontheim,	63 26	10 24	2 15	
Temingen, *l.f.* 100 ft.	63 30	9 2		
Agdenæs, *l.f*, 116 ft..	63 38	9 43		
Munkholmen, *l.f.*44ft	64 27	11 8		
Villa Oen, I.*l.f.* 124ft..	64 33	10 42		
Præstöe, I. *l.f.* 37ft....	64 47	11 8		
Werro island	67 42	11 25		
North cape...........	71 10	25 50	3 44	
Kilduin island	69 9	34 21	7 0	
Nagel island..........	68 25	37 85		

Places.	Lat.	Long.	times	rise
	° ′	° ′	h m	ft.
Cape Svenin noss......	68 11N	39 47E	8 20	
Cape Kanin noss	68 39	43 32		
Archangel	64 32	40 34	6 0	
Cross island..........	66 27	40 28	4 15	
SWEDEN,				
Hallö, *l.r.* 6m	58 29	11 18		
Maestrand,I.*l.r.*8m.292f	57 54	11 38		
Winga, I. *l.f.* 39ft.....	57 38	11 39		
Gottenburg,	57 41	11 54		
Buskär, *l.f.*	57 38	11 42		
Botto, *l.f.* 45ft......	57 39	11 45		
Nidingen, 2 *l.f.*	57 18	11 55		
Morups Tange, *l.f.*70ft.	56 55	12 23		
Kulla mt. *l.r.* 8m 283ft.	56 18	12 29		
Helsingborg, *l.f.*	56 3	12 43		
Malmo, *l.f.* 50ft.	55 37	13 2		
Falsterbo, *l.f.* 74ft. ...	55 23	12 51		
Utklippan, *l.r.*2m.50ft.	55 57	15 42		
Oland, *l.f.* 130ft..	56 12	16 25		
Calmar,				
Gemskar, *l.f.*	56 40	16 24		
Ostergarn I. *l.f.* 75ft...	57 27	19 0		
Landsort.*l.r.*2m.145ft..	58 44	17 54		
Korsso, *l.i.*4m. 151ft...	59 17	18 58		
Grönskär, *l.f.* 103ft. ..	59 17	19 3		
Soderarm,*l.r.*2m. 99ft..	59 45	19 26		
Svartklubb, *l.f.* 68ft. ..	60 10	18 50		
Djursten, *l.f.* 62ft.....	60 22	18 30		
Orskär, I. *l.r.*1m.113ft.	60 32	18 24		
DENMARK,				
Scaw, *l.f.* 67ft.	57 44	10 37	12 0	15
Faldstrand.	57 27	10 33		
Sebye.	57 20	10 33		
Aalburg.............	57 3	9 36		
Grenaae.	56 25	10 53		
Aarhuys	56 9	10 13		
Apenrade............	55 3	9 26		
Flensburg	54 47	9 26		
Sleswick.............	54 31	9 34		
ZEALAND,				
Kioge...............	55 27	12 12		
Copenhagen *l. f.* 31ft...	55 41	12 35		
Elsineur.............	56 2	12 38		
Cronburg, *l.f.* 113 ft. ..	56 2	12 37		
Head lights	56 7	12 22		
Nykoping	55 55	11 40		
Callandburg..........	55 40	11 6		
Korsä light *l. f.*........	55 20	11 9		
Wordingburg.........	55 1	11 57		
CATTEGAT,				
Huen, I. Uraniberg....	55 54	12 42		
Amag, I. Drago *l.f.*....	55 35	12 41		
Haselow island	56 12	11 42		
Anholt, *l.i.* 3½m. 123ft .	56 44	11 39		
Little mid. ground	56 57	11 56		
Lessoe I. east end.....	57 19	11 12		
West end..........	57 15	10 53		
Trindelen rock *l.s.* 26ft.	57 25	11 16		

TABLE 44.

LATITUDES AND LONGITUDES.

Places.	Lat.	Long.	times	rise
	° '	° '		ft.
DANISH ISLES,				
Fuen, Odensee	55 24N	10 24E		
Lanland, Rudkop..	54 57	10 44		
Aroe, Kiop	54 54	10 26		
Alsen, Sonderborg .	54 55	9 49		
Laaland, Naskoi . .	54 51	11 10		
Falstar, Nykoping .	54 50	11 54		
Moen, Stege......	54 59	12 19		
Fermeren, Borge...	54 27	11 17		
SWEDEN,				
Tralleberg	55 22	13 11		
Cimbritshamn.....	55 34	14 20		
Ahus	55 56	14 16		
Carlscrona........	56 10	15 34		
Torum point	56 5	15 50		
Calmar..........	56 40	16 21		
Vestervyk	57 45	16 40		
Soderkoping	58 29	16 20		
Nykoping	58 45	17 2		
Trosa............	58 53	17 33		
Landsort *l.r.* 2m145ft	58 44	17 54		
Stockholm	59 21	18 4		
GERMANY,				
Kiel, *l.f.* 33ft8	54 20	10 8		
Lubeck	53 51	10 40		
Wismar	53 53	11 39		
Rostock	54 3	12 17		
PRUSSIA,				
Dars head	54 29	12 38		
Gellen light	54 28	13 13		
Stralsund.........	54 19	13 5		
Rugen, *l.f.* 188ft...	54 40	13 30		
Bergen...........	54 24	13 32		
Usedom..........	53 53	14 4		
Wollin...........	53 48	14 44		
Stettin	53 23	14 33		
Cammin..........	53 56	14 56		
Colberg	54 7	15 47		
Rugenwalde.......	55 22	16 30		
Heel, *l.r.* 113ft. ...	54 35	18 48		
Dantzic	54 21	18 38		
Pillau............	54 38	19 54		
Konigsberg	54 43	20 30		
Bruster Ort lights..	54 58	19 59		
Memel	55 42	21 8		
RUSSIA,				
Libau............	56 32	20 55		
Windau	57 26	21 27		
Lyserort	57 35	21 38		
Domesness lights...	57 47	22 32		
Runo I. *l.f.* 79ft. .	57 49	23 7		
Riga.............	56 57	24 6		
Pernau...........	58 21	24 24		
Dago, Simperness..	59 6	22 32		
Dagerort, *l r.* 538ft.	58 55	22 12		
Osel, Palmer Ort ..	58 40	22 28		
Hunds Ort	58 32	21 50		
Swasve Ort light.	57 56	22 0		

Places.	Lat.	Long.	times	rise
	° '	° '	h m	ft.
Arensburg	58 15N	22 28E		
Gatska Sando	58 26	19 18		
Faro, N.E. end....	57 56	19 29		
Gottland, N.E. end.	57 51	19 7		
Wisby	57 39	18 26		
Hoborg	56 57	18 13		
Oland, north end...	57 22	17 6		
Borgholms Slott..	56 52	16 37		
South end light ..	56 13	16 24		
Eartholms	55 19	15 15		
Bornholm N.W.end.	55 18	14 49		
Hasle	55 10	14 47		
Hasle, S.E. end....	54 58	15 14		
Svanike	55 8	15 16		
FINLAND.				
South Coast,				
Odensholme light...	59 19	23 19		
Great Roge light...	59 25	24 5		
Surep head light ...	59 28	24 24		
Nargen, I. N.point.	59 36	24 33		
Revel............	59 26	24 46		
Kokskar light	59 40	25 3		
Stone Skar........	59 46	26 26		
Little Titters I. ...	59 47	27 0		
Great Titters I... .	59 50	27 17		
Lavenskar, N. end .	59 59	27 54		
Seascar light	59 58	28 28		
Narva............	59 23	28 14		
Dolgenos.........	59 53	29 6		
Tolbecon light.....	60 0	29 39		
Cronstadt.........	59 59	29 49		
Petersburg........	59 57	30 19		
North Coast,				
Hango, *l i.* 100ft. ..	59 46	22 56		
Helsingfors	60 10	25 2		
Borgo............	60 21	25 45		
Lovisa	60 25	26 26		
Orrengrunds beacon	60 15	26 35		
Hogland I. lights...	60 3	27 7		
Aspo	60 14	27 22		
Frederichsham.....	60 30	27 25		
Wiburg	60 43	28 46		
Styrs Udden	60 9	29 10		
BOTHNIA,				
Uto light	59 47	21 22		
Abo	60 27	22 17		
Wasa	63 5	21 42		
Tornea	65 51	24 12		
Gefle.............	60 40	17 8		
DENMARK,				
Scaw, *l.f.*	57 44	10 37	12 0	15
Robsnout.........	57 25	9 45		
Oyster head.......	57 10	8 58		
Holmen..........	57 8	8 38		
Point Horn	55 34	8 5	12 0	
GERMANY,				
Heligoland light ...	54 11	7 53	11 0	

TABLE 44.

LATITUDES AND LONGITUDES,

Places.	Lat.	Long.	times	rise
	° ′	° ′	h m	ft.
Elbe R. red buoy...	54 0N	8 21E	12 0	
Nework	53 55	8 31		
Cuxhaven..........	53 52	8 43	1 0	
Glukstadt..........	53 48	9 27		
Stade	53 36	9 28		
Hamburg..........	53 33	9 59	6 0	
Bremen	53 5	8 48	6 0	
Emden............	53 22	7 13	12 0	
Gottingen obs......	51 31	9 56		
HOLLAND,				
Harlingen	53 10	5 25		
Texel, south point..	53 2	4 33	6 45	
Alkmaer..........	52 37	4 38		
Amsterdam	52 22	4 53	3 0	17
Haarlem	52 22	4 39	9 0	
Leyden...........	52 9	4 24		
The Hague........	52 4	4 19		
Hollands Hoek.....	51 56	4 0	3 0	
Rotterdam........	51 55	4 29	3 0	7
Goeree...........	51 49	3 54	1 48	
Schowen lights.....	51 42	3 42		
Walcheren I. W.pt.	51 32	3 25		
Middleburg	51 30	3 38		
Flushing..........	51 27	3 35	1 20	35
NETHERLANDS				
Antwerp..........	51 13	4 24	4 25	
Helvoetsluys,*l.f.* 46ft	51 49	4 8		
Bruges...........	51 13	3 14		
Ostend...........	51 14	2 55	12 0	16
Nieuport	51 8	2 45	11 15	
Furnes...........	51 4	2 40		
Dunkirk, *l.f.*	51 2	2 23	11 40	19
Berg	50 58	2 26		
Gravelines	50 59	2 8	11 45	18
Calais............	50 58	1 51	11 30	18
FRANCE,				
Northern Coast,				
C. Grisnez, *l.f.* 194ft	50 52	1 35		
Boulogne.........	50 44	1 37	11 0	
Etaples...........	50 31	1 39	10 30	19
Le Crotoy	50 13	1 36	10 35	
S.Valery sur Somme	50 11	1 31		
Eu	50 3	1 15		
Dieppe light 43ft...	49 56	1 4		
Ailly light	49 55	1 10	10 30	18
Fecamp	49 45	0 23		
Havre, *l.f.*.........	49 29	0 6	10 0	19
Harfleur..........	49 30	0 13	10 0	22
Honfleur..........	49 25	0 14		
Carentan	49 18	1 15	9 30	
St. Marcouf I.	49 30	1 9W		
C.Barfleur,*l.r.* 1½m. 236ft	49 42	1 17	7 30	
Cherbourg,2*l.f.* 85ft	49 39	1 37	7 45	20
Pelée isle	49 40	1 35		
C.la Hague,*l.f.* 157ft	49 43	1 57	7 45	
Alderney I. fort. ..	49 45	2 8	6 45	
Caskets, 3*l.r.*15s79ft	49 45	2 26	6 45	18
Guernsey I. S.Pierre.	49 26	2 33	6 30	32
Sark I. west end...	49 25	2 24		

Places.	Lat.	Long.	times	rise
	° ′	° ′	h m	ft.
Jersey island,				
C. Gossness.....	49 16N	2 13W		
St. Aubin	49 11	2 8		
St.Clement's pt..	49 10	1 59		
Chausey island.....	48 52	1 51		
Granville	48 50	1 36		
Mount St.Michael..	48 38	1 31		
Pontorson	48 33	1 32		
Cancalle..........	48 41	1 51	6 0	
St. Malo..........	48 39	2 1	6 0	45
C.Frehel, *l.r.* 2¾m. 246ft	48 41	2 19	6 0	45
St. Brieu.........	48 31	2 44		
Brehat I. *l f.* 49 ft..	48 55	3 5	7 30	36
Morlaix...........	48 35	3 54	5 15	30
I. Bas, *l.r.* 1m.223ft	48 45	4 1		
St.Pol de Leon	48 41	4 0		
Blanche rock......	49 1	3 58		
St.Anthony's lights.	48 50	4 29		
Ushant, *l.f.* 272ft..	48 29	5 3	3 45	20
Western Coast,				
St Matthew's light..	48 20	4 46	3 0	21
Brest.............	48 23	4 28		
Pt.Ras, *l.f.* 259ft...	48 2	4 44		
Saints rocks.......	48 5	5 5		
Glenan islands.....	47 45	4 0		
L'Orient	47 45	3 21	3 30	20
Port Louis........	47 43	3 21		
I. de Groix,*l.f.*194ft	47 38	3 29		
Quiberon, south pt.	47 27	3 4		
Belle I. *l.r.*1m.276ft	47 19	3 13		
Houat island	47 24	2 57		
Hedic island.......	47 22	2 51		
Vannes	47 39	2 45	3 45	
Croisic...........	47 18	2 31	3 45	
Paimbeuf.........	47 17	2 2	5 30	
Nantes...........	47 13	1 33	4 0	
Bourgneuf........	47 3	1 51		
Le Pilier, *l.f.* 105ft.	47 3	2 22		
Noirmoutier,I. S.pt.	47 0	2 14	3 45	
Isle de Dieu,W.pt..	46 42	2 19	3 0	
St.Gilles..........	46 40	1 52		
Olonne shoals	46 30	1 47		
I.Ré, *l r.*1¾m. 95ft.	46 15	1 34		
St.Martin.......	46 12	1 22		
Rochelle..........	46 9	1 10	3 45	
Rochefort.........	45 56	0 58	4 15	
Oleron,I. *l.f.* 164ft.	46 3	1 24	3 45	18
Aix island	46 2	1 11	3 0	
Cordovan,*l.r*1m207f	45 35	1 10	3 [illegible]	
Bourdeaux........	44 50	0 34	3 0	
Cape Feret........	44 43	1 15		
Cape Breton.......	43 46	1 26		
Bayonne..........	43 29	1 28	3 30	
SPAIN,				
N. and W. Coasts				
Fontarabia........	43 21	1 46		
St.Sebastian light ..	43 20	2 0	3 15	
Cape Machicao	43 28	2 49		
Santona, mount....	43 27	3 26		
Santander.........	43 28	3 46	3 15	15

LATITUDES AND LONGITUDES.

Places.	Lat.	Long.	times	rise
	° ′	° ′	h m	ft.
Cape de Mar	43 30N	4 49W		
Cape Lastres	43 34	5 12		
Gijon	43 35	5 35		
Cape Penas	43 42	5 48		
Cape Busto	43 36	6 23		
Cape Vares	43 47	7 43		
Cape Ortegal	43 47	7 56	3 0	
Cape Priora	43 34	8 19		
Corunna	43 24	8 20		
Cape St.Adrian	43 21	8 48		
Cape Villano	43 11	9 11		
Cape Torrinana	43 4	9 18		
Cape Finisterre	42 54	9 20	3 0	
Cape Cerrobedo	42 34	8 59		
Ons island, N.point.	42 24	8 50		
PORTUGAL,				
Vigo	42 15	8 44	3 45	
Cape Silleiro	42 6	8 48		
R.Mino, entr.	41 53	8 47		
Vianna	41 43	8 43		
Oporto (entrance to)	41 11	8 40	3 15	
Aveiro	40 39	8 43		
Cape Mondego	40 12	8 55		
Carvœira	39 21	9 27		
Lisbon, obs.	38 42	9 8		
Cape Espichel	38 25	9 13		
St. Ubes, *l.f.*	38 29	8 54		
Cape Sines	37 57	8 54		
Cape St.Vincent	37 4	9 0	2 15	13
Lagos	37 8	8 40	2 0	13
Cape Carvoera	37 7	8 20		
Cape St.Maria	36 55	7 49		
Pt. St Anthony	37 10	7 20		
SPAIN,				
St.Lucar	36 46	6 20		
Cadiz *l.r.* 2m.138ft.	36 32	6 17	4 0	9
Cape Trafalgar	36 9	6 1		
Tarifa,I.*l.r.*2¼m125f	36 0	5 38	12 0	7
Gibraltar	36 7	5 21		
Malaga, *l.r.* 1m.	36 43	4 24		
Motril	36 45	3 33		
Almeira	36 51	2 31		
Cape Gatta	36 43	2 9		
Cape Tinoso	37 31	1 6		
Carthagena	37 36	1 0		
Cape Palos	37 38	0 41		
Plana island	38 10	0 29		
Alicante	38 21	0 28		
Cape St.Martin	38 48	0 11E		
Denia	38 52	0 5		
Valencia	39 28	0 24W		
Cape Oropesa	40 6	0 16E		
River Ebro, entr.	40 42	0 57		
Terragoña, *l.f* 55ft.	41 8	1 16		
Barcelona	41 22	2 9		
Cape de Tosa	41 43	2 55		
Palamos	41 52	3 4		
C.St.Sebastian, *l.f.* 205ft	41 54	3 13		
C. Creux	42 19	3 20		
S.Coast of France				
Cape Leucate	42 50N	3 2E		
Fort Brescou	43 16	3 30		
Cette, *l.f.* 197ft.	43 24	3 42		
Agiues light	43 34	4 12		
Arles	43 41	4 38		
Marseilles	43 18	5 24		
La Ciotat	43 11	5 37		
Fort St.Louis	43 6	5 50		
Toulon	43 7	5 55		
Cape Bonet	43 5	6 24		
Camarat Tour	43 10	6 40		
St.Tropez	43 16	6 38		
Frejus	43 26	6 44		
Antibes	43 35	7 8		
St.Marguerite I.	43 31	7 3		
Nice	43 39	7 16		
Ville Franca, *l.f.* 225ft	43 40	7 19		
ITALY, *West Coast,*				
Cape Melle	43 57	8 12		
Savona	44 17	8 29		
Genoa	44 25	8 53		
Point Venere	44 4	9 53		
Pisa obs	43 43	10 24		
Leghorn	43 34	10 18		
Vado tower	43 23	10 26		
Piombino	42 55	10 32		
Cape Troja	42 47	10 41		
Civita Vecchia	42 5	11 45		
Ostea	41 45	12 13		
Cape Danso	41 26	12 38		
Mount Circello	41 12	13 3		
Gaeta	41 15	13 34		
Naples obs.	40 52	14 16		
Salerno	40 44	14 46		
Cape Licosa	40 14	14 53		
Policastro	40 6	15 40		
St.Euphemia	38 55	16 32		
Tropea	38 36	16 7		
Point Pezzo	38 14	15 39		
Gulf of Venice,				
Cape Spartivento	37 56	16 3		
Cape Stillo	38 29	16 37		
Cape Colonne	39 5	17 14		
Point Alice	39 24	17 10		
Tarento	40 28	17 14		
Gallipoli	40 3	17 56		
Cape St.Mary	39 40	18 23		
Otranto	40 9	18 30		
Brindisi	40 38	18 5		
Bari	41 7	16 52		
Manfredonia	41 37	15 55		
Viesti	41 52	16 11		
Termoli	42 0	15 0		
Ortona	42 21	14 27		
Ancona	43 38	13 30		
Pesaro	43 55	12 55		
Revenna	44 25	12 13		

LATITUDES AND LONGITUDES.

Places.	Lat.	Long.	times	rise
	° ′	° ′	h m	ft.
Comachio	44 42N	12 12E		
Pt.della Maestra	44 59	12 32		
Venice	45 26	12 20		
Trieste, *l.r.*	45 39	13 46		
Rovigno	45 5	13 38		
C.Promontoire	44 45	13 54		
Ionian Islands				
Corfu,citadel,*l.* 240ft	39 37	20 6		
Paxo *l.f.* 369ft.	39 13	20 9		
Parga	39 16	20 23		
Patras castle	38 14	21 47		
C. Viscardo	38 29	20 33		
Ithaca town	38 22	20 43		
Zante, C.Kieri	37 38	20 50		
Stamfanes, *l.* 127ft.	37 15	21 1		
TURKEY, *and Archipelago.*				
Ragusa	42 38	18 6		
Pt. d'Ostro	42 24	18 31		
Kattaro	42 27	18 31		
Durazzo	41 18	19 27		
C. Linguetta	40 26	19 15		
Butrinto	39 43	20 1		
Lepanto	38 22	21 50		
C. Papas	38 12	21 23		
Coron	36 48	22 0		
C. Matapan	36 21	22 29		
C. St. Angeli	36 25	23 12		
Cerigo	36 7	23 4		
Caravi	36 46	23 35		
Spezzia	37 16	23 8		
Egina	37 42	23 30		
Athens	37 57	23 38		
C. Nicolas	38 44	24 4		
Karysto I.	37 56	24 32		
Zea I.	37 37	24 22		
Serpho I.	37 10	24 30		
Milo	36 40	25 23		
Santorin	36 22	25 29		
Naxia	37 2	25 31		
Paros	37 3	25 12		
C. Doro	38 6	24 30		
Skyro I.	38 49	24 34		
Piperi I.	39 20	24 20		
Salonica	40 39	28 57		
C. Trepano	39 57	22 57		
Mount Athos	40 10	24 20		
Castle of Asia	40 9	26 23		
Marmora	40 37	27 46		
Constantinople	41 0	28 59		
Europæ	41 14	29 7		
Lemnos	39 50	25 11		
C. Bada	39 29	26 4		
Mitylene	39 15	25 57		
C. Karabara	38 41	26 28		
Smyrna	38 27	27 10		
Samos	37 44	26 39		
Patmos	37 17	26 35		
Rhodes	36 27	28 14		
Candia	35 21	25 8		

Places.	Lat.	Long.	times	rise
	° ′	° ′	h m	ft.
C. St.Mary	37 42N	27 0E		
BLACK SEA,				
Varna	43 12	27 56		
Serpents island	45 15	30 11		
C.Fontane, *l.f.*203ft.	46 22	30 44		
Odessa	46 29	30 44		
C.Tarkhan, *l.f.*108ft	45 21	32 29		
Sevastopol	44 36	33 29		
Trebizond	41 0	39 45		
C. Yassour	41 8	37 40		
Sinope	42 3	35 10		
S. Coast and Islands of the Levant and Mediterranean.				
Cape St.Mary	37 42	27 0		
Cape Krio	36 41	27 20		
Seven Capes	36 20	29 10		
C. Tristomos	36 9	29 49		
C. Khelidoni	36 12	30 26		
C. Anamour	36 0	32 50		
C. Karadash	36 33	35 15		
C. Khynzyr	36 15	35 60		
Alexandretta	36 36	36 16		
Latakia	35 30	35 47		
Bairut	33 50	35 30		
Mount Carmel	32 52	35 0		
Jaffa	32 3	34 44		
El Arish	31 5	33 48		
C.Buyau	31 32	31 55		
Rosetta	31 25	30 26		
Alexandria	31 13	29 53		
Ras al Harseit	31 25	27 5		
C. Luco	31 58	25 5		
C. Rezat	32 57	21 39		
C. Tejones	32 0	20 0		
C. Mezurat	32 25	15 10		
Tripoli	32 55	13 8		
C. Burdj Kadija	35 10	11 10		
Cape Bon	37 6	11 3		
Bizerta	37 13	9 46		
C. Fierro	37 2	7 10		
Algiers	36 47	3 4		
C. Ferrat	35 54	0 22W		
C. Tres Forcas	35 28	2 56		
Ceuta	35 54	5 16		
C. Spartel	35 48	5 56		
Alboran	35 56	3 0		
Palma, *l.f.*	39 34	2 40E		
Port Mahon	39 54	4 21		
C. Asinara	41 5	8 18		
Gagliari	39 13	9 9		
Bastia	42 40	9 27		
Palermo	38 7	13 22		
C. Passari	36 42	15 10		
Malta, La Valette	35 55	14 31		
WESTERN COAST OF AFRICA.				
C. Spartel	35 48	5 56W		
El Araish	35 13	6 9		

TABLE 44.

LATITUDES AND LONGITUDES.

Places.	Lat.	Long.	times	rise
	° ′	° ′	h m	ft.
NewSalee, or Rabat.	34 3N	6 48W		
Mazagan	33 15	8 36		
Cape Blanco	33 8	8 38		
Cape Cantin	32 32	9 14		
Saffia	32 20	9 8		
Mogadore island	31 30	9 50		
Cape Gheer	30 37	9 54		
Cleveland shoal	30 45	10 38		
Santa Cruz	30 28	9 38		
Cape Nun	28 46	11 3		
Cape Blanca	27 54	12 42		
Cape Bajadore	26 7	14 29		
Cape Barbas	22 19	16 39		
Cape Blanco	20 46	17 4	9 45	
Cape St. Ann	20 36	16 45		
Cape Myrik	19 25	16 34		
Portandick	18 15	16 8		
Point de Breberie, entr. to Senegal	15 52	16 34	10 30	
St. Lewis island	16 4	16 31		
Cape Verd	14 44	17 31		
Goree island, fort	14 39	17 25	7 48	
Cape Naze	14 34	17 12		
River Gambia, Cape St. Mary	13 30	16 41	8 10	
James Fort	13 20	16 26		
Cape Roxo	12 22	16 51		
Cape Verga	19 19	14 23		
DeLos I. south point	9 26	13 51		
Leopards island	8 41	13 15		
C. Sierra Leon	8 30	13 15	7 30	
Cape Shilling	8 10	13 10		
Banana island	8 6	13 16		
Tassa point	7 56	13 2		
Cape Ann	7 34	12 57		
Cape Mount	6 43	11 21		
Var. 19 ·40′W.				
Cape Mesurada	6 19	10 46		
Grand Bassa	5 52	10 33		
River Sestos	4 39	9 40		
Sangwin	5 14	9 8		
Krou Settra	4 50	8 48		
Grand Cestos	4 41	8 20		
Cape Palmas	4 23	7 45		
Var. 19 ·40′W.				
Tabou point	4 28	7 11		
St. Andrew's river	5 0	6 4		
Cape Lahou	5 12	4 36		
Grand Bassam	5 20	3 22		
Cape Appollonia	5 3	2 35		
Axim	4 48	2 18		
Cape Three Points	4 54	2 2		
Dixcove fort	4 48	1 59		
Secondee	5 4	1 57		
St. Sebastian's fort	5 7	1 33		
Elmina castle	5 5	1 22		
Gold Coast,				
C. Coast castle	5 6	1 13		
Annamaboe	5 9	1 9		
Kormantine fort	5 7N	0 51E		
Tantumquerry point.	5 14	0 49		
Barracoe point	5 22	0 33		
Accra	5 32	0 12		
Ningo	5 45	0 2		
Adda castle	5 48	0 44		
Cape St. Paul's	5 46	0 52		
Quitta	5 54	0 34		
Little Popoe	6 16	1 36		
Whyda	6 20	2 15		
Lagos	6 26	3 22		
Cape Formosa	4 15	6 11		
New Calabar river	4 22	7 4		
Cameroons Cape	3 53	9 25		
Cape St. John	1 10	9 22		
Gaboon R. C. Clara	0 30	9 18		
Cape Lopez	0 36S	8 35		
Low Point	2 0	9 37		
River Setté	2 23	10 30		
Cape Mayumba	3 23	10 35		
Var. 21°W.				
Loango river	4 39	11 44		
C. Padron, entr. to Congo river	6 10	12 15		
Var. 21°30′W.				
Ambriz bay.	7 56	13 3		
Dande	8 23	13 16		
Cape Ledo	9 46	13 12		
Novo Redondo	11 37	13 47		
Var. 22°W.				
S. Phil. de Benguella	12 34	13 25		
Cape Negro	15 41	11 55		
Tigers island	16 29	12 3		
Cape Frio	18 23	12 2		
Village	21 53	14 40		
Walwich Bay	22 52	14 22	1 54	
Var. 23°W.				
Ilea point	23 30	14 48		
Bird island	24 37	14 27		
Angra Pequena	26 38	15 4		
Cape Voltas	28 44	16 32		
St. Helen's bay, Cape St. Martin	32 39	17 52		
Saldanah bay, N.pt.	33 1	17 54		
Dassen island	33 26	18 7		
Table bay, Robin I.	33 48	18 22	2 25	5
Cape Town obs.	33 56	18 29		
C. of Good Hope	34 22	18 29		
Hangklip Cape	34 24	18 50		
Var. 28°12′W. 1826				
Islands in the NORTH ATLANTIC OCEAN,				
Bermudas I. town	32 22N	64 33W		
Azores, or W. Is.				
Corvo, south point	39 41	31 3		
Flores, west point	39 24	31 12		
Fayal, S.E. point	38 31	28 42		
Pico, east point	38 26	28 28		
St. George, S.E point	38 29	27 51		

TABLE 44.

LATITUDES AND LONGITUDES.

Places.	Lat.		Long.		times		rise
	°	′	°	′	h	m	ft.
Graciosa,							
Villa de Praya...	39	3N	28	1W			
Terceira, Angra....	38	39	27	13	11	5	6
St.Michael, west pt.	37	54	25	56			
Pta. Delgada....	37	45	25	42			
East point......	37	48	25	10			
Formigas.........	37	17	25	54			
St.Mary town.....	36	58	25	13			
South-east point.	36	56	25	6			
Madeira,							
Porto Santo town..	33	3	16	19			
Madeira,							
East point......	32	44	16	38	12	4	
West point.....	32	49	17	16			
Funchal........	32	38	16	55	12	15	
S;Dezertos,							
South point.....	32	29	16	31			
Salvages, large isle..	30	8	15	57			
Canary,							
Palma,							
North point.....	28	52	17	57	3	0	
Ferro............	27	47	17	56			
West point.....	27	44	18	9			
Gomero, port.....	28	6	17	7			
Teneriffe, peak....	28	16	16	30			
Orotava........	28	25	16	31			
Santa Cruz.....	28	28	16	15			
Grand Canary.....	27	56	15	32			
Fuerteventura,							
South-west point.	28	4	14	29			
Lancerot, east rock.	28	48	13	18			
Alegranza, east point	29	26	13	31			
C. Verd Isles,							
St.Antonio, N. pt..	17	12	25	5			
South end......	16	55	25	19			
St.Vincent town...	16	54	25	0			
St.Lucia, north pt..	16	49	24	47			
St.Nicholas, N.pt..	16	42	24	41			
East point......	16	34	24	0			
Sal I. south-east pt.	16	34	22	57			
Bonavista, N.W.pt..	16	13	22	56			
Mayo town.......	15	8	23	14			
St. Jago,							
Port Praya......	14	54	23	31	6	0	
Var. 15°W.							
Fogo, north point..	15	1	24	22			
Brava............	14	49	24	44			
Penado de St.Pedro.	0	55	29	23			
Islands in the South Atlantic,							
Fernandez Po, peak.	3	35S	8	46E			
Princes island.....	1	37	7	27			
St.Thomas's isle...	0	27	6	40			
Annabona........	1	24	5	38			
Ascension.........	7	55	14	27W			
St. Helena,							
James town obs..	15	55	5	44	1	30	
Fernd.de Noronha..	3	51	32	25	4	0	

Places.	Lat.		Long.		times		rise
	°	′	°	′	h	m	ft.
Roccas...........	3	55S	33	43W			
Trinidad island....	20	31	29	22			
Martin Vas.......	20	29	28	54			
Tristan d'Acunha..	37	6	12	2			
Inaccessible island..	37	17	12	33			
Nightingale island..	37	26	12	21			
Gough's island ...	40	20	9	44			
Falkland islands,							
Port Egmont....	51	21	60	5			
Cape Meredith....	52	16	60	39			
From the CAPE of GOODHOPE to CANTON,							
Eastern C. of Africa							
C. ofGood Hope obs.	33	56	18	29E	2	20	
Cape Agulhas.....	34	51	20	2			
Cape Infante......	34	31	20	53			
Cape Vaches......	34	20	21	51			
Cape St.Blaise....	34	7	22	12	3	0	
Cape Recife.......	34	2	25	40			
Point Padron......	33	47	26	25			
Natal Cape.......	29	53	31	2	10	5	13
Point St.Lucia....	28	33	32	23			
Cape Vidal.......	28	9	32	38			
English river....	25	58	32	36	5	20	
Cape Corrientes....	24	8	35	31			
Cape Inhamban....	23	52	35	20			
BazarutoI. north end	21	31	35	33			
Sofala fort........	20	11	34	46			
Quilimane point...	18	1	37	1			
Mafamede......	16	21	39	59			
Mozambique fort..	15	1	40	47	4	18	
Cape Delgado.....	10	41	40	40			
Songa Songa......	8	32	39	30			
Zanzibar I. south pt.	6	28	39	33	4	45	
Mombas..........	4	4	39	43	4	0	11
Brava...........	1	7N	43	58			
Mukdeesha........	2	2	45	25			
Cape Guardafui....	11	49	51	20			
Ras Mett.........	11	55	50	52			
Socotra I. west point	12	33	53	23			
Madagascar, and adjacent Islands							
Cape St.Mary.....	25	39S	45	7			
St.Augustin's Bay							
Sandy island....	23	38	43	33			
Cape St.Vincent...	21	54	43	20			
Cape St.Andrews...	16	11	44	31			
Table Cape.......	15	43	46	6			
Cape St.Sebastian..	12	26	48	40			
Cape St.Ambro....	12	2	49	24			
St.Mary's island...	17	0	49	49			
Foul point........	17	41	49	32			
Point Ytapare.....	24	59	47	3			
Port Dauphin.....	25	1	46	57			
Bassas de India....	21	29	39	41			
Europa rocks......	22	22	40	24			
Juan de Nova.....	17	3	52	42			
Barren island......	18	41	43	53			
Coffin island......	17	30	43	47			

LATITUDES AND LONGITUDES.

Places.	Lat.	Long.	times	rise
	° ′	° ′	h m	ft.
Mayotta peak......	12 54S	45 19E		
Johanna peak	12 13	44 29		
Mohilla, north point.	12 36	43 11	4 45	12
Comoro, N.E.point.	11 19	43 39		
John Martin's isle ..	10 19	43 30		
Aldabra I. E.point.	9 26	46 35		
Assumption, SE.pt.	9 46	46 34		
Cosmoledo islands..	9 43	47 40		
St.Peter's islands...	9 19	50 50		
Astove islands	10 7	57 43		
Providence island ..	9 14	51 11		
Inverarity, or Alphonso island. .	7 0	52 42		
Amirante I. E.pt ..	5 24	53 23		
Eagle island.....	5 7	53 29		
Curreuse island....	4 16	55 42		
African islands.....	4 53	53 28		
Seychelle or Mahe ..	4 38	55 32		
Praslin island	4 17	55 39		
Coetivy island	7 9	56 19		
Roderigue	19 41	63 30		
Mauritius, or Isle of France, Port Louis......	20 9	57 29	12 30	
Bourbon, St.Dennis.......	20 50	55 31		
Eastern C.of Arabia				
Ras Morebat	16 55N	54 43		
Zingera	17 7	55 2		
Noss...........	17 23	55 11		
Koorya Moora isle Tibly	17 26	56 16		
Soda...........	17 28	55 49		
Cape Sangha......	18 9	56 30		
Rus Madraka	18 58	57 46		
Markass.	19 10	57 41		
Massera I. Abor... Rassas	20 8	58 53		
Ras Alif, or Hulf ..	20 40	58 49		
Zibsh..........	21 26	59 7		
Al Hubba	22 15	59 44		
Jins	22 26	59 46		
Al Had	22 34	59 43		
BunderSoore,E.pt..	22 36	59 20		
Boo Dahood.......	23 21	58 54		
Muskat	23 37	58 38		
Malabar Coast				
Cape Arubah......	25 16	64 31		
Diu point.........	20 42	71 6		
St.John's point	20 3	72 58		
Bombay *l.*........	18 54	72 53	11 10	17
Severndroon	17 48	73 9		
Dabul	17 46	73 11		
Goa	15 28	73 53		
Algoada point	15 28	73 46	11 15	
Carwar head.......	14 47	73 56		
Pigeon island......	14 1	74 17		
Barcelore.........	13 51	74 51		
Mangalore........	12 51	74 53		
Mount Dilly	12 2	75 12		
Cananore *fl.st.*.....	11 57N	75 7E		
Tellicherry........	11 45	75 30		
Sacrifice rock	11 30	75 31		
Calicut *fl.st.*	11 15	75 46		
Cochin *fl.st.*........	9 58	76 14		
Coromandel Coast,				
Cape Comorin.....	8 6	77 30		
Manapar point	8 22	78 4		
Point Calymere ...	10 17	79 51		
Negapatam........	10 45	79 51		
Tranquebar	11 0	79 52		
Cuddalore	11 43	79 48		
Pondicherry	11 56	79 49		
Madras, Fort St.George ..	13 4	80 17		
Pulicat...........	13 25	80 18		
Point Divy	15 57	81 10		
Masulipatam	16 10	81 8		
Point Gordewar....	16 43	82 32		
Visagapatam	17 41	83 17		
Ganjam	19 23	85 3		
False Point *l.*	20 19	86 48		
Palmiras, *l.house* ...	20 41	87 5		
Saugor,Middletonpt.	21 38	88 3		
Calcutta, Fort William....	22 35	88 17		
Chandernagor.....	32 51	88 30	3 5	
Light-house point..	21 28	88 25		
Islamabad	22 20	91 45	2 30	
Burman,				
Cape Negrais......	16 2	94 16		
Diamond isle......	15 52	94 19		
Martaban.........	16 31	97 7		
Rangoon	16 45	96 15		
Tavay point.......	13 32	98 15		
Malay,				
Slipper island	7 20	98 29		
Queda fort........	6 0	100 17		
Prince of Wales isld. Fort Cornwallis..	5 24	100 22		
Malacca..........	2 12	102 15		
Point Romania ...	1 23	104 16		
Sincapore *fl.st.*	1 16	103 53		
China,				
Camboja point.....	8 40	104 55		
C. St.James	10 17	107 5		
C. Avarello	12 55	109 25		
Turon cape	16 5	108 22		
Mandarine's cape ..	21 28	112 30		
False St.John's I. South point.....	21 34	112 50		
Macao *fl.st.*	22 11	113 32		
INDIAN OCEAN *Islands, &c.*				
Pr.Edward's isles, Middle.........	46 46S	37 55		
Desert islands.....	48 5	48 0		

LATITUDES AND LONGITUDES,

Places.	Lat.	Long.	times	rise
	° ′	° ′	h m	ft.
Kergulen's land,				
Christmas harbr.	48 41S	69 2E		
Cape George	49 55	70 12		
St. Paul's island	38 42	77 52		
Amsterdam island	37 52	77 35		
Cloates island	22 6	112 30		
Christmas island	10 32	105 33		
Cocos, or				
Keeling's islands.				
Northernmost	11 50	97 0		
Ceylon Island,				
Point Pedro	9 49 N	80 18		
Point de Galle	6 1	80 14		
Dondra hd.	5 55	80 38		
Elephant hill	6 20	81 25		
Trincomalee *fl.st.*	8 34	81 13	6 0	
Andaman Islands,				
Great Andaman				
Port Cornwallis	13 21	93 13	4 30	
Little Andaman,				
South-east point	10 26	92 40		
The Brothers	10 59	92 50		
Sumatra,				
Diamond point	5 18	97 48		
Lucipara island	3 14	106 10		
Flat point	5 55	104 40		
Bencoolen	3 49	102 20		
Indrapour point	2 12	100 41		
Cape Felix	3 47	96 15		
Acheen head	5 40	95 32		
Hog island, N W.pt.	2 50	95 32		
Pulo Njias, N. pt.	1 36	96 55		
Pulo Batoa, N. pt.	0 10	98 45		
Java head	6 48	105 12		
Batavia obs.	6 9	106 53		
Indramayo point	6 15	108 21		
C. Sandana	7 39	114 36		
East point	8 39	114 37		
Wine Cooper's point	7 30	106 20		
Bantam point	5 51	106 3		
Carawang point	6 0	107 2		
Samarang *fl.st.*	6 57	110 26		
Sourabaya	7 12	112 45		
Madura isle, N.W.pt.	6 53	112 43		
Timor isle, S.W.pt.	10 23	123 30		
North-east point	8 20	127 15		
Borneo Island,				
North point	7 2N	116 40		
Point Sambar	3 0	110 19		
Tanjong Apee	2 0	109 20		
Borneo	4 55	114 45		
Palawan, south pt.	8 22	117 20		
North point	11 20	119 37		
Philippine Islands,				
Mindanao	6 54	122 7		
C. St. Augustine	6 24	126 48		
Samar,				
St. Espiritu Santo.	12 34N	125 17E		
Luconia,				
Manilla	14 36	120 54		
Capones point	14 54	120 3		
Boliano point	16 25	119 53		
Cape Bajador	18 28	120 38		
Cape Enganno	18 39	122 20		
Formosa I. south end	21 54	120 55		
Tayoan	22 35	120 32		
North-east end	25 11	121 56		
Haiman I. north pt.	20 2	110 40		
Japan Isles,				
Pinnacles islands	29 58	129 58		
Gotto I. S.W. end.	32 34	128 44		
Asses Ears	32 3	128 38		
Nangasaki	32 45	129 52		
Niphon I. S.W. end	34 5	131 30		
Cape Noto	37 36	137 20		
C. Sangaar	40 58	140 28		
C. Nambu	39 50	142 30		
C. King	34 54	140 21		
Fatsisio island	33 6	140 0		
Jeddo city	35 40	139 50		
East Coast China				
Canton	23 8	113 17		
Macao	22 12	113 34	9 52	10
Grand Ladrone	21 57	113 46		
Grand Lema, W.pt.	22 2	114 14		
Pedra Branca	22 19	115 8		
Amoy	24 21	118 16		
Quesan isles	29 22	122 12		
Chusan island N.pt.	31 16	121 56		
Ningpo	29 58	120 18		
Yang tse-hiang-ho.	31 32	121 41		
Nankin	32 5	118 47		
Staunton's island	36 47	122 13		
Cape Gower	36 57	122 19		
Kisanson	37 38	121 23		
Tontchoo-foo	37 50	120 36		
Sa-lou-poo-tien	38 55	118 43		
Pekin	39 54	116 29		
C. Clonard	36 5	130 0		
Kinghing	42 10	131 24		
C. Lesseps	49 30	140 22		
Vaujuas point	52 12	141 45		
Kamschatka,				
Ochotsk	59 20	143 14		
Yamsk	60 46	154 30		
C. Lopatka	51 2	156 46		
Kamtchatska Ness.	56 1	163 23		
East Cape	66 6	169 44		
North Cape	68 56	179 11		
Sachalin Island				
North point	54 24	142 47		
C. Crillon	45 54	141 58		
Boutin point	51 52	141 53		
C. Patience	48 52	144 46		

LATITUDES AND LONGITUDES.

Places.	Lat.		Long.		times		rise
	°	′	°	′	h	m	ft.
C. Aniwa.........	46	2N	143	30E			
Staten I. S.W. end.	44	30	146	40			
Company's I.							
Cape Schouten ..	46	0	150	20			
Kurule islands.....	46	10	151	30			
St.Lawrence's I. ..	63	30	170	30			
VanDieman's Land							
South-west cape...	43	32 S	146	6			
South cape	43	37	146	49			
Tasman's head.....	43	32	147	20			
Cape Pillar........	43	12	148	6			
C. Coxcomb.......	42	43	148	14			
St.Patrick's head...	41	42	148	20			
Largest Swan I. ...	40	43	148	0			
Cape Portland.....	40	44	147	56			
Port Dalrymple....	41	4	146	47			
Hunter's isles	40	24	144	50			
King's I. north pt, .	39	36	144	0			
Furneaux islands...	40	34	148	10			
Kent's group......	39	27	147	15			
New South Wales							
C. Otway.........	38	56	143	26			
Wilson's promontory	39	12	146	20			
Cape Howe.......	37	35	150	5			
Botany bay	33	32	151	25	8	0	7
Port Jackson, *l. r.*							
350 ft.	33	51	151	18	8	19	
Cape Byron.......	28	28	153	36			
Sandy Cape.......	24	42	153	16			
Cape Flattery......	14	53	145	16			
Cape York........	10	43	142	29			
VanDieman's cape..	11	8	130	20			
North-west cape ...	21	48	114	4			
Dirk Hartog's.....	25	32	112	48			
Melville I. north pt,.	11	0	130	30			
Cape Leuwen......	34	19	115	6			
Cape Talbot.......	14	0	127	0			
Cape Butholet.....	17	10	122	0			
Port Lincoln......	34	48	135	44			
New Zealand							
North cape	34	24	173	0			
Cape East	37	42	178	40			
Bank's peninsula ..	43	30	173	0			
Molineaux harbour.	46	15	169	30			
Cape South	47	17	167	18			
Cape Paliser.......	41	38	175	21			
W.C. of AMERICA							
Cape Horn	55	59	67	16W			
Diego Ramirez I. ..	56	25	68	36			
St Ildefonso I......	55	48	69	15			
C. Gloucester.....	54	30	73	1			
C. Pillar.........	52	42	74	44			
C. St.Lucia.......	51	30	75	25			
Madre de Dios,							
C. Santiago.....	50	45	75	25			
C. Montague....	49	7	75	36			
C. Tres Montes ...	46	59	75	27			
Point Quilan......	43	36	74	27			

Places.	Lat.		Long.		times		rise
	°	′	°	′	h	m	ft.
St. Carlos	41	52S	73	50W	11	45	19
Quidal point.......	41	5	74	15	11	40	7
Valdivia..........	39	49	73	18			
Mocha island......	38	20	73	50			
Valparaiso	33	2	71	43			
Coquimbo	29	55	71	26			
Choros point	28	55	71	14			
Copiapo..........	27	20	71	2			
Arica	18	28	70	25			
Ylo, Point Coles...	17	40	71	25			
Port Caballos......	15	5	75	35			
Lima	12	3	77	7			
Truxillo	8	7	79	3			
Guyaquil	2	11	79	53			
Pt. St. Elena	2	12	81	0			
Cape de Lorenzo...	1	0	80	58			
C. St. Francisco ...	0	40N	80	0			
Guascama point....	2	26	78	22			
Cape Corentes	5	30	77	30			
Cape Marietta......	7	15	80	37			
Quibo island,							
South-east cape..	7	16	81	45			
Point Burcia.......	8	1	82	88			
Cape Blanco	9	30	85	37			
Pt. St. Catherine...	10	26	85	42			
Pt. Desolado	11	50	86	42			
Pt.Remedios.......	13	33	89	45			
Pt.Gatamalia	13	54	90	53			
Acapulco	16	50	99	52			
Cape Correntes	20	25	105	40			
St. Blas	21	30	105	16			
Tres Marias, northpt	21	22	106	25			
Cape St. Lucas....	22	53	109	50			
Morro Hermosa ...	27	48	114	58			
Port Diego	32	40	117	17			
Point Conception ..	34	32	120	7			
Monterry.........	36	36	121	43			
Port St.Francisco ..	37	48	122	24			
C. Mendocino.....	40	29	124	32			
C. Blanco, or							
Orford Cape	42	52	124	15			
C.Disappointment..	46	19	124	0			
Cape Flattery	48	23	124	20			
Cape Scott........	50	48	128	25			
Pta. de Gonzalo ...	48	28	122	53			
C. St. James	51	57	131	15			
Langara, or							
North island	54	25	133	10			
Cape Ommaney....	56	10	134	34			
Cape Spencer......	58	13	136	24			
Admiralty Bay,							
Point Phipps....	59	33	139	48			
Cape Suckling.....	60	0	143	45			
E. C. of America							
Cape Horn	55	59 S	67	16			
Cape St.John......	54	43	63	44			
Cape Blanco.......	47	12	65	44			
Port. St. Elena, obs.	44	31	65	22			
Cape Corrientes....	38	5	57	29			
C. St. Antonio.....	36	20	56	46			
Montevedio	34	54	56	13			

LATITUDES AND LONGITUDES.

Places.	Lat.	Long.	times	rise
	° ′	° ′	h m	ft.
Rio Grande de San Pedro	32 7 S	52 8W		
St. Catherine's I.				
North point	27 23	48 28		
Santos	24 1	46 22		
Grand island	23 12	44 17		
Rio Janeiro	22 54	43 9		
Espiritu Santo	20 20	39 30		
Cape St. Augustine	8 21	34 56		
Cape St. Roque	5 28	35 17		
Cape North	1 10	50 0		
Cayenne	4 56N	52 19		
R. Marony, port	5 44	54 2		
Surinam, Brams pt.	5 51	55 24		
R. Essequebo, entr.	7 0	58 20		
Pt. Baxa	9 33	61 0		
Pt. Pena	10 43	61 53		
Cape Three Points	10 45	62 52		
Cumana, pt. Araya	10 38	64 22		
C. Codera	10 35	66 4		
Guayra	10 36	66 58		
Porto Cabello	10 29	68 0		
Cape St. Roman	12 11	70 8		
Pt. Gallinas	12 25	71 42		
Pape Vela	12 10	72 11		
Sta. Marta	11 20	74 15		
Cartagena	10 25	75 34		
Pt. St. Blas	9 33	78 40		
Porto Bello	9 34	79 39		
C. Gracios a Dios	14 59	83 11		
C. Cameron	16 2	85 13		
Truxillo	15 50	86 3		
C. Catouche	21 31	87 0		
Pt. Salinas	21 31	88 10		
Pt. Palmar	21 3	90 18		
Campeche	19 50	90 33		
Vera Cruz	19 12	96 9		
C. Roxa	21 38	97 20		
River Bravo, entr.	25 50	97 28		
R. Mississipi, entr	29 5	89 5		
Florida,				
C. Sable	25 0	80 57		
WEST INDIA ISLANDS.				
Bermudas,				
St. George town	32 22	64 33		
Great Bahama,				
West end	26 41	79 3		
Seal Key	27 1	78 16		
New Providence				
Nassau	25 5	77 21		
Eleuthera I. north pt	25 35	76 43		
Powell's point	24 40	76 18		
Yuma, or Long I.				
North-west point	23 38	75 25		
South-east point	22 52	74 50		
Cat island	24 42	75 50		
Columbus point	24 10	75 25		
Watling's island				
North-east point	24 8	74 26		
Attwood's Key,				
East point	23 10N	73 30W		
Great Crooked I.	22 48	74 19		
Mogane island,				
North-west pt.	22 28	73 12		
Great Inaqua,				
North-west point	21 27	73 40		
Gt. Caycos, N. pt.	21 59	72 0		
Cuba.				
C. Maysi	20 17	74 7		
Havanna,				
Morro	23 10	82 22		
C. Antonio	21 55	84 58		
Jamaica.				
Morant point	17 56	76 11		
South Negril	18 16	78 22		
Port Royal	17 56	76 52		
Grand Cayman				
Fort George	19 18	81 24		
St. Domingo	18 28	69 59		
C. Tiberon	18 22	74 28		
Porto Rico	18 29	66 13		
Barbuda, north pt	17 46	61 55		
Guadaloupe,				
Fort des Irois	16 0	61 45		
Dominica,				
Roseau	15 20	61 25		
Martinique,				
Port Royal	14 35	61 4		
St. Lucia,				
Savanna	13 47	60 55		
St. Vincent				
Kingston	13 12	61 15		
Barbadoes,				
Bridgetown	13 5	59 45		
Grenada,				
Fort St. George	12 3	61 48		
Tobago,				
Melville rocks	11 21	60 32		
Trinidad,				
Point Gelera	10 51	60 54		
The East Coast of N. AMERICA,				
Okkak	57 30	62 45		
C. Sable	25 2	81 15		
Ball, or Long I. S. pt	24 55	80 43		
C. Florida	25 41	80 15		
C. Canaveral	28 18	80 25		
St. Augustine	29 48	81 28		
Port Royal	32 18	80 36		
Charleston, *l.r.* 125ft.	32 40	79 40		
Georgetown	33 22	79 15		
C. Fear	33 48	78 9		
C. Lookout, *l.f.* 95ft.	34 36	76 36		
C. Hatteras, *l.f.* 95 ft.	35 15	75 30		
Henlopen, *l.f.* 180ft.	38 47	75 6		
New York	40 45	74 0		
Montuc point *l.f.* 160	41 4	71 55		

LATITUDES AND LONGITUDES.

Places.	Lat.		Long.		times		rise
	°	′	°	′	h	m	ft.
Rhode Island,							
Newport	41	30N	71	19W			
Nantuket I. *l.f.* 70ft.	41	23	70	1			
Cape Cod, *l.f.*180ft.	42	5	70	6			
Boston town, *l.r.*82ft	42	22	71	3	11	25	12
Cape Ann,							
Thatcher's *l.*	42	40	70	38			
Portland *l.*	43	39	70	15			
Manan I. north pt. .	44	46	66	49			
Seal I. south point. .	43	28	66	0			
Cape Sable.........	43	24	65	38			
Sambro head *l.*	44	26	63	35			
Cape Canso	45	20	61	0			
Scatery I. S.E.pt . .	45	58	59	38			
C. Breton I.							
C. North...... ..	47	6	60	22			
Pr.Edward's I.....							
C. North........	47	7	63	55			
E. point	46	22	61	50			
Miscou I. entr. to. .							
Chaleur bay E. pt. .	47	57	64	30			
C. Gaspa.........	48	45	64	12			
Anticosta I. E. pt...	49	5	61	44			
West point	49	52	64	35			
NEWFOUNDLAND,							
Cape Ray..........	47	37	59	20			
Cape Anguille	47	55	59	22			
Cape St. George ...	48	28	59	15			
South head	49	6	58	22			
C. St. Gregory....	49	20	58	15			
Point Riche.......	50	40	57	23			
Point Ferolle......	51	2	57	5			
C. Norman.......	51	38	55	50			
Belle Isle, N. pt. . .	51	58	55	15			
Quirpon island	51	40	55	25			
Hare Bay, entr. ...	51	17	55	45			
C. St.John	50	9	55	38			
Fogo island, N. pt. .	49	45	54	5			
C. Freels.........	49	18	53	23			
C. Bonavista......	48	42	53	8			
Point Garates	48	10N	52	50W			
C. St.Francis	47	48	52	51			
C. Race..........	46	40	53	8			
LABRADORE,							
C. Charles.........	52	15	55	20			
Sandwich bay,S.C. .	53	48	56	21			
C. Webuck	54	55	57	40			
Hopedale..........	55	30	59	45			
C. Chudleigh, S.pt. .	60	14	64	55			
Hudson's Strts, entr.							
Resolution I. S.E. pt	61	22	64	55			
Davis Straits, entr. .							
C. Walsingham....	66	0	60	50			
C. Farewell.......	59	49	43	54			
GREENLAND,							
Puesortok	64	58	40	30			
C. Brewster	70	10	22	0			
John Mayen's I. ...	71	8	8	10			
Bontokoe..........	73	29	21	9			
Gale Hawkes point. .	74	57	19	0			
ICELAND.							
North Cape.......	66	29	22	28			
Langaness.........	66	23	14	32			
C. Reikiavik	64	9	21	56			
SPITZBERGEN,							
South Cape	76	32	15	0			
Fair Foreland, NW.	78	53	10	0			
Amsterdam island							
Hackluyts head. .	79	46	10	50			
Magdalena bay	79	33	11	0			
Verleegen Hook ...	80	3	16	30			
Hope I.N E. pt....	76	30	20	37			
Bear, or							
Cherry island....	74	40	20	0			
Walden I..........	80	30	20	0			
Ryk Ice island	77	45	23	40			

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